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WHAT IS NEW THIS MONTH

Table of Contents for February

LEADING ARTICLES

COAL FROM CABBAGES	<i>By Grover C. Mueller</i>	17
How the synthetic chemist's new magic affects your daily life		
BUILDING THE GREATEST BRIDGE	<i>By Edwin Ketchum</i>	20
Marvels of a colossal structure to span the Hudson River		
SNUFFING OUT A GIANT CANDLE	<i>By John E. Lodge</i>	22
How daring men fought and won a thrilling battle with a flaming oil well		
WASHINGTON AND LINCOLN BOTH WERE INVENTORS <i>By Homer Croy</i>		23
Little-known triumphs of two of America's great men		
NEW PROOFS THAT ANIMALS REALLY CAN THINK <i>By Robert E. Martin</i>		24
Amazing feats of dumb creatures' intelligence		
PROSPECTING FOR GOLD BY ELECTRICITY	<i>By George Lee Dowd, Jr.</i>	26
Finding buried treasure with a pair of headphones		
LIQUEFIED HELIUM BOILS ON ICE AND "FREEZES" TIN <i>By Arthur A. Stuart</i>		27
Strange new uses for America's fireproof airship gas		
A NEW GUIDE TO THE HEAVENS		29
Where astronomers have found thousands of new universes		
S O S!—A CHALLENGE TO SCIENCE	<i>By Frederick Tisdale</i>	30
What inventors are doing to avert sea disasters		
IF YOU HAD MILLIONS TO SPEND—	<i>By Michel Mok</i>	32
An unusual interview with Harry Guggenheim, godfather of flight		
RINGSIDE SEATS ON THE OCEAN BOTTOM		33
Taking movies of sharks and suckers from a "hole in the sea"		
THE REAL FATHERS OF FLIGHT	<i>By John R. McMahon</i>	42
Continuing the intimate story of Orville and Wilbur Wright		
TIDES MAKE THE EARTH BOIL OVER	<i>By Edwin W. Teale</i>	43
How new facts are solving the mystery of why volcanoes erupt		
NOW YOU CAN EAT SUNSHINE	<i>By Frank Parker Stockbridge</i>	47
Newest uses of invisible ultra-violet light		
SKY RAILWAY RUNS TO STRANGE HOTEL		49
An engineering wonder of the Alps		
NEW MARVELS OF PLANE DESIGN	<i>By Robert T. Pound</i>	53
Why airplanes can't be built like automobiles		
WHEN THE SKY RAINS SOLDIERS!		55
Remarkable experiments in fighting battles with parachutes		

SPECIAL FEATURES

COVER DESIGN	<i>By Herbert Peas</i>	
IMPOSING A SAVING SENTENCE ON A SPENDTHRIFT <i>By Wallace Ames</i>		6
How to keep money after earning it		
HELP FOR YOU IN BUILDING		12
Announcing a valuable new service of Popular Science Institute		
OUR READERS SAY—		14
WHY TWO SETS MAY LOOK ALIKE, BUT BEHAVE DIFFERENTLY	<i>By John Carr</i>	64
What goes on inside a radio receiver		
REWIRING FOR A. C. SIMPLIFIED	<i>By Alfred P. Lane</i>	65
Short-cuts for the amateur builder of sets		
DECORATIVE METAL SAWING	<i>By Edwin Thatcher</i>	76
What you can do with a jeweler's blade		
PING-PONG TABLE FOLDS INTO SCREEN	<i>By Charles A. King</i>	77
An unobtrusive outfit for a newly popular game		
CONTROLLING A MODEL RAILWAY	<i>By Frederick D. Ryder, Jr.</i>	78
Tricks in running miniature trains		
TURNING RINGS OF WOOD	<i>By Herman Hjorth</i>	79
A master craftsman tells how to make rounded pieces		
LUXURIES TO ADD TO THE HOME	<i>By Milton G. Sturgies</i>	80
A glimpse at the new comforts of the 1929 model		
EDITORIALS		82
WHAT FEEDS GAS TO YOUR CAR?	<i>By Martin Bunn</i>	84
Gus and Joe discuss fuel supply systems		

Astronomy

Screen Production Shows Motion of Planet	62
New Comet Discovered by an Amateur	70
Oceans on Frozen Planet May Be Liquid Air	73

Automobiles

Steam-Puffing Granddaddy of Modern Auto Found	57
Know Your Car	57
Invents New Front-Wheel Drive for Autos	61
Tractor Sets 1,330-Mile Endurance Record	63
Swinging Auto Crib Rocks the Baby to Sleep	78
One Time in Five It's the Train That Is Hit	79
Clowed Car Has Removable Top to Admit Sunshine	72
"Auto Wheel Minus a Hub" Designed to Save Weight	72
Inflates Soft Tire with Air from the "Square"	79
Oregon Village Sees Its First Automobile	73
Every Little Dial Has a Meaning	73
Women Drivers Can Signal Now—No Excuse	75
Removing Radiator Obstructions	86
A Tool Compartment Lock	86
Both Doors Open at Once	86
When the Battery Is Dead	86
Blowing Starts Siphon	86
Ten Dollars for an Idea	88

Aviation

Finless Safety Monoplane Flies with Hands Off	40
Invents Gyroscope to Balance Planes	40
Convertible Balloon-Dirigible	40
Test Three-Bladed Propeller	40
Old All-Metal Dirigible Nearly Ready to Fly	40
Climb Seven Miles to Take Air Pictures	40
Huge Searchlight Batteries for Eastern Airport	41
"Ghost" Airplane Nearing Completion	41
More Records Smashed	41
A Great Seaplane Harbor	41
Silencing Roar of Planes	41
First to Fly in Antarctic	41
Planes Wear Life Buys	41
New Gun Sprays Bullets	41
New Material for Airship Bags	50
Airplane Explorers Find a New Sugar	52
Plan World's Largest Airplane Plant	56
Air Landmarks Should Be Yellow, White, Black	60

"Beams" of Sound to Guide Aircraft in Fog	62
Bird's-Eye View from Plane Reveals Buried City	72
Fights Fire in the Air	151
"Prop" Blades Made Hollow	152
Hops from Train—Crash!	152
"Aerial Fish Express"	152
Duration Record Stands	152

Engineering

Five-Mile Highway Built Across James River	50
Bolstering Up the Leaning Tower of Pisa	63
Suspended by Crane, House Rides Across River	62
World's Greatest Gas Line	73

Exceptional People

This Dentist Had Courage	57
He Built His Own Castle—on the Ground	68
He Made American Flag of 33,000 Wheat Kernels	70
Paints First Scientific Portrait of Spectrum	71

Health and Hygiene

New Cancer Hope	50
Weak Feet Walk on Air in New Arch Support	50
Life Span 100 Years by 1930? Experts Differ	57
Masks Safeguard Health of Paint Spray Users	58
Compressed Air Drill New Aid to Surgeons	59
Grafts Part of Human Eye in Amazing Operation	61
Tests Show Canary Bird Is Best Gas Detector	63
Doctor Makes 7,000-Mile Call by Radio	72
Colds Blamed on Lack of Proteins in Diet	73

Laboratory Discoveries

An Artificial Heart!	51
Studies Thunderbolts from a Glass Cage	51
Invisible Purses Photographed!	63
"Lightning" in Auto Motor	64
New Experiment Confirms Findings of Einstein	66

Models

Making Movie Thrills with Tiny Toys	34
Traffic Problems Revealed by Working Models	60
Building the Buckeye State	92
Whittling Model Propellers	104

Nature

"Busy Bee" a Myth—He's a Loner, Tests Show	58
Rocky Mountain Wilds Are Preserved for Science	56
English Hurd for Parrots	58
Big Trees, Centuries Old, Found to Be Fireproof	59
Tiny Ocean Plants Build Houses of Health Glass	71
Landmarks Guide Pigeons Home?	71
New Sugar Discovered in Dahlia Juice	74
Lizard Hypnotized!	75
If Brain Size Counted, the Whale Would Be Smart	75
A New Kind of Mosquito! This Makes 111	76
From Mountains of Mystery	130
Killed by Too Much Light	130

New Devices for the Home

New Electric Blender	38
Straight-Edge Ladle Gets Food Out	38
Handy "Automatic Pincushion"	38
Extracts the Last Drop of Orange Juice	38
Gas Refrigerator and Range in One	38
Ice Pan Has a Handle	38
Waffle-Iron with Built-In Thermometer	38
Novel Frying Fork	39
Egg-Timing Alarm Clock	39
Springs Operate Odd Kitchen Chairs	39
Wall Hawk Sings the Clothes-line	39
Newest Holder for Steel Wool	39
Keeps the Percolator Top from Falling Out	39
Combination Toaster and Percolator	39
Nugget Salt and Pepper Shaker	39
Makes Either Coffee or Tea	39
Electric Sandwich Toaster	39
Built-In Medicine Cabinet Has Adjustable Mirror	39

New Processes and Inventions

Drives Rocket Motorcycle	77
Detects Artificial Pearls	30
Swimming Turtle Is Hour Hand of Naval Clock	56
Air Propeller Drives Naval Catapult	50
Soldering Jobs Simplified by Electric Furnace	57
Traveling Shears Clear Phone Lines of Litter	60
Self-Dumping Snow Turns Scurry in the Water	61
New Hand Truck Picks Up Piles of Boxes	62
Principle of Range Finder Applied to Depth Gauge	64
Fabricated Lumber Cut in Labor-Saving Shapes	69
Amazing Machines Do Work of an Office Force	69
"Fountain Pen" Pistol Can Shoot Deadly Bullets	69
Would Foil Bank Robbers	70
A Mechanical Substitute for Tailor's Shears	70
Poking Pushcart Runs on Rubber-Tired Wheels	73
Three-Wheeled Motorcycle Runs on Endless Tread	71
Novel Card Table Serves Also as Movie Screen	71
Dry Cell Blasting Device Resembles Flashlight	71
Tin Can Filling Station for Cigarette Lighters	74
Tiny Dynamo Operates New Batteryless Flashlight	74
Holder for Pipe Cleaners	75
Novel Lamp Cord Holds Cigarette Lighter	75

Radio

Radio Pictures Made Lifelike	58
A Useful Transformer Test	67
When Batteries Play Out	67
A B C's of Radio	67
Handy Radio Aerial Mast Clamps to the Roof	69
Stations Identified by This Radio Dial	74

Unusual Facts and Ideas

One Jump Ahead of Death!	26
Modern Cave City	37
Light Organ Paints Scenery	37
Necklace 35,000 Years Old	39

Each Cuke Has Its Number	59
Farms in the Sahara?	59
Will the Ocean Overflow?	59
The Tropics in a Bot	51
No Fire in Bedheads!	51
Every Man His Own Still	51
Cathedral Blasted from Cliffs	52
Human Body's Electricity Reported Photographed	56
Opals, Once Feared, Today Yield Vast Fortunes	57
Latest Ice Cream Cone Wears a Bonnet	57
Searchlight on Wheels Aids Fire Fighters	58
Camerasnap Snaps Torpedo Diving into Waves	58
Gypsum Increases Soil's Capacity for Moisture	59
Tribesmen Jail Idols if Prayers Are Unanswered	58
Begin Search for Diamond Fields in Canada	59
Your Busy Heart Is Fed by Tiny "Dinner Pills"	59
Rubber Band Returns Ball in One-Man Tennis	60
Chemical Makes Open-Air Ice Skating July Sport	60
Catch Birds in Fish Nets	61
Where Half of the World's Gold Is Weighed	61
Speeding Typists' Fingers with Radio "Jaws"	62
Walls Hide Radiators in Novel Heating System	63
Bunning Gowns of Metal Soon May Be the Style	64
Pot Milk in the Dark to Keep It Fresh	69
Urge Metal Storage for War Needs	69
Nobility Not Degenerate, Genealogists Assert	70
Europe May Soon "Eat" Its "Drinks" in Solid Form	70
Gives American "Talkies" Foreign Tongue	70
Find Rare Handwork of Cave Men Jewelers	71
Road Signs Teach Geology	72
Holland Tunnel Handles 8,000,000 Cars in a Year	72
Colored Telephone Poles to Liven Landscape	73
Tin Foil Amazingly Thin	74
Did Man's Legs Develop Before His Head?	74
"Rheumatics" a Real Storm Warning	75
Colored Snapshots—When?	150
The Men Prefer Blue	150

For the Home Owner

Upholstering Old Chairs	102
Fastening Objects to Plaster Walls	127
How to Waterproof Shoes	128

Hints for the Mechanic

Time-savers for Shop Men	84
Old Bill Says	94
Turning Oversize Work in a Lathe	90

Ideas for the Handy Man

Now for Winter Sports	90
Choosing a Paint Sprayer	100
Cannon for Shooting Snowballs	101
Blueprints for Your Home Workshop	103
Varnishes in the Home Workshop	108
Weatherstrip for Bottom of Storm Door	121
"What Can I Make from a Block?"	129

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Imposing a Saving Sentence On a SPENDTHRIFT

By WALLACE AMES, Financial Editor

THE usual mess of monthly bills had arrived, checks were drawn and the accounts paid. In addition to the current household bills there were a number of extras representing Christmas presents, holiday expenses and one or two luxuries which Mr. and Mrs. Matthews had allowed themselves.

All in all, after the bills were met there was just enough left in the bank account to see the family through until next payday.

"Same old story," remarked Mrs. Matthews in a sort of half-resigned, half-discouraged tone. "Another month goes by without our adding anything to our savings. It was the same all through last year. First thing we know another new year will slip by and we won't be any better off than we are now. How far did we actually get, Ralph, on that program we started a year ago New Year's to lay by at least \$75 each month?"

"Not very far," replied Ralph Matthews, himself none too well pleased with the way they were making out. "Of course we banked the Christmas check from the Company as a starter, just as we did this year. But every month during 1927 one thing or another took the money. Expenses, expenses, expenses, just like a pack of wolves, seem waiting to snap up each month's salary the minute it reached our hands."

"When we were figuring things out the end of last year I was sure we could save \$75 a month, and I still know that we ought to have done so. It should be easy to save at least that much out of our income. But there was nobody making me save and every month—February, March, April and May—right through the year, we spent for one thing or another the money we ought to have put aside for the future. And it was the same the year before, and the one before that. Why is it that the habit of spending money is so much easier to form than the habit of saving it?"

II

Across the street lived a family whose circumstances were about the same as the Matthews'. But in their home, the same evening, quite a different scene was taking place than the one just depicted. Being the 10th of the month, John Maxwell and his wife were also settling their monthly accounts. As the first order of business, Maxwell drew a check to a building and loan association.

"Did you see this notice from the B. & L., Olive?" asked John. "It says that after the current payment our shares mature. We have been making these \$75 monthly payments now for a little over 11 years. According to my account we

have paid in a total of \$10,200 . . . and now we are going to get back \$15,000!"

"What a lot of money!" exclaimed Olive Maxwell. "What will we do with it? Of course, we have known it was coming some day, but now that the day has almost arrived, I am overwhelmed with the thought of having so much money."

"I have been wondering myself what to do with the money," replied John, "and I have an idea to suggest. We are getting along nicely now, and do not need to draw on the income from our \$15,000 . . . in fact, I see no reason why we should not keep right on saving out of our monthly earnings. But the idea I have is this: If we invest our \$15,000 at 6% it will pay \$900 a year, or \$75 a month. Why not use that to start a new series of B. & L. shares? When they mature we will get another \$15,000, making \$30,000 in all gained from the \$10,200 we have now saved. That will put us on easy street."

"That's a peach of an idea," Olive Maxwell agreed.

Both Matthews and Maxwell earned about the same salary . . . both families maintained about the same scale of living. There was only one important difference in the two as far as progress in getting ahead was concerned: The Matthews tried to save *without a plan*; the Maxwells saved *with a plan*. The Matthews saved *what was left*, if anything, after satisfying all their spending desires; the Maxwells *saved first*, and kept their spending within what remained.

People who find it difficult to get ahead with regularity usually manage to pay their rent and household bills each month, but they do not put their savings and investments in the same class with monthly expenses . . . as a regular monthly charge against income. If a man earning \$6,000 a year should suddenly lose his position and have to take another paying \$5,000, his family would manage to get along on the smaller income. There is room in any income for regular saving, if it is planned for. The only way to get ahead is to make your savings just as rigid a charge against income as current expenses.

For those who experience difficulty in saving with regularity, the Building & Loan plan is an admirable one to adopt. It demands regularity. And it pays a handsome reward for regularity. It demands regularity not for just a year, but for a number of years, until the amount saved, and the income it produces amounts to a worthwhile sum.

The Building & Loan plan originated over a century ago. (Continued on page 8)

Imposing a Saving Sentence on a Spendthrift

(Continued from page 4)

primarily as a means of aiding people to own their homes. But, associations have also achieved immense popularity among people who want to save money. While building and loan associations vary in certain respects, the following points apply more or less to all of them.

A fundamental of all associations is their co-operative character. They operate on a very economical basis, have very little overhead, and all shareholders participate on the same basis, according to the number of their shares, in the profits derived from loaning money to property owners.

This co-operative feature enables shareholders to obtain an unusually high return on their money. The profit in matured B. & L. shares is equivalent to approximately 5% to 7% compound interest or 6% to 8% simple interest.

One may deposit as little as \$5 a month or as large a sum as he is able. On regular shares it is necessary to deposit the same amount each month. Many associations impose small fines on delinquents but these fines are used to swell the profits of all shareholders. The aggregate monthly deposits of shareholders is kept invested in real estate mortgages. Interest is not credited to shareholders' accounts monthly, or quarterly, as in a bank, but is re-invested and thus compounded. All the profits are paid at one time, when the shares mature. Each share matures at \$200, representing approximately \$138 savings and \$62 profit. (The exact figures vary, according to the profits the association gains from its investments.)

Many associations also sell "full paid" or "income" shares. These permit outright investment of such sums as \$100, \$200, etc., and pay a stated rate of interest—4½% to 6%, according to the association.

Building and Loan associations are subject to state banking regulations and enjoy an honorable safety record. The B. & L. plan is fundamentally sound and the protection to shareholders compares with other safe financial institutions.

The great popularity of Building and Loan is indicated by these figures: For the year ended December 31, 1927 there were 12,710 local building and loan associations belonging to the United States League of Building and Loan Associations; they had a total of 11,905,000 investors, whose savings and profits up to that date amounted to \$7,062,523,000.

The rapid growth of these associations in the last five years is shown by comparing the above figures with those applying to December 31, 1923, at which time there were 10,744 associations with a total membership of 7,202,880, whose savings and profits up to that date amounted to \$3,942,932,880.

The outstanding usefulness of a building and loan account is the fact that it makes saving compulsory; it forces the individual to save regularly and to keep it

(Continued on page 6)

A vacation that lasts the rest of your life

HOW would you like to quit work some day and start out on a vacation for the rest of your life?

How would you like to pack your trunk, cash a good-sized check at the bank, pick up a traveler's map and decide which part of the world you would like to visit first?

Or perhaps you would prefer to settle down in a cozy cottage in the mountains or by the sea—a comfortable place where you can spend the rest of your days just doing the things you've always wanted to do "when you had time."

Sounds attractive, doesn't it? No more work. No more worries. Nothing but good times ahead, and of course, with all expenses paid.

The money question

But where is the money coming from? Who is going to pay your expenses?

The answer is simple. All you have to do is to rearrange your present financial life slightly and the money question will take care of itself.

All you have to do is follow a simple but definite plan, and by the time you are ready to retire and take that vacation the money will be waiting for you.

This plan was devised by financial experts. It has been tried out by thousands of men and women. It is backed by a 100 million dollar Life Insurance Company. It is safe as a Government Bond.

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And if you should become permanently disabled and unable to make further payments on your investment, there would be no need for worry. Your payments would be made for you out of a special fund laid aside for that purpose.

This Free Book explains it

A 24-page, illustrated booklet, called "How to Get the Things You Want," explains the plan in detail. It tells not only how you can retire with an income when you are 65, but how you can leave your home free of debt—how you can send your children to college—how you can create an estate—how you can make sure your income will go on even though you should become totally disabled—how you can leave an income for your family.

The financial plan outlined in this book is so clear and so simple that it can be understood at a glance. It is so sound, so sensible, so logical that the minute you read about it you will realize that it works. Send for your copy of the free book today. There is no obligation.



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- 4 CREATE an estate.
- 5 MAKE SURE your income will go on even though you become totally disabled.
- 6 LEAVE an income for your family.



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Imposing a Saving Sentence on a Spendthrift

(Continued from page 5)

up for a number of years, until his accumulations really amount to something.

Another advantage is the fact that all profits are accumulated, re-invested and paid in a lump sum when the shares mature, instead of being paid in dribbles. The most important result of this feature is the liberal profit ultimately paid to the investor.

The Financial Department of POPULAR SCIENCE MONTHLY likes the building and loan plan because it is a strong force in forming the regular saving habit, it pays the investor a liberal income and it is a convenient method for both well-to-do people and those in moderate circumstances to provide for their financial future.

Most every community has one or more building and loan associations, but those who do not live near one may invest by mail with any of the prominent associations in New York or elsewhere.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"How to Build an Independent Income" is the title of a new booklet by the F. H. Smith Company which explains conclusively how people of moderate means may obtain financial prosperity. "55 Years of Investment Service" describes the history of progress of the F. H. Smith Company as well as making an attractive suggestion in first mortgage real estate bonds. May be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with \$100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 30 Broadway, New York. Ask them for Booklet IT.

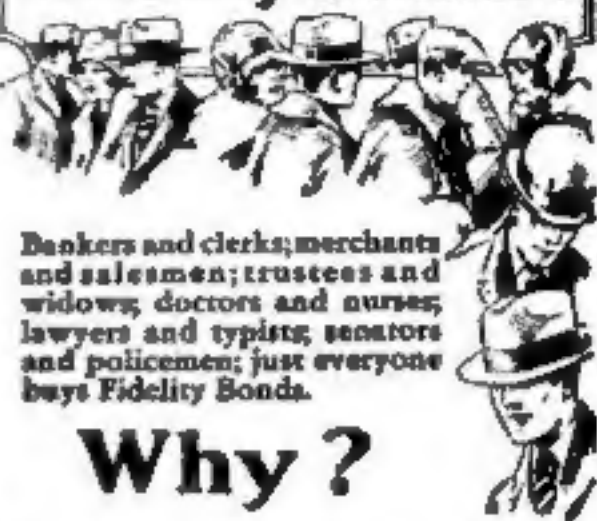
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Suppose, for example, you could point to a cut of freight costs from four per cent of gross sales to two per cent, on a sales volume running into the millions—as did W. H. Story, experienced, successful traffic manager for an Ohio corporation . . .

Or suppose you could point to some twenty-seven suggestions you had already made to your company, representing savings from \$20 to \$75 daily—as did J. R. Hollingsworth, in charge of a shift of men at one of the big factories in Akron . . .

Or suppose, as a trained salesman, you could increase the sales in your ter-

ritory 50 per cent—as did I. A. Gould, district manager for Michigan for the Smith Agricultural Chemical Company, Columbus, Ohio.

Or suppose that the balance sheet of your employer showed that—through your knowledge, as accountant, of the various factors that determine the success of a business enterprise—you had turned a loss into a profit—as did E. W. Neir, manager of the Hotel Rowe, Grand Rapids.

Or suppose you could demonstrate specialized ability in Personnel Management, say, or Business Correspondence, or any one of a dozen other attractive fields of business where good men are always in demand and where proved ability quickly finds its reward in increased responsibility and increased pay.

How could any business man who was blessed with sense be persuaded to part with your services—when very clearly those services were showing him a handsome profit?

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How to avoid SORE THROAT . . . and Colds



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Tests show amazing power against bacteria

Kills typhoid germs in 15 seconds

MORE than fifty diseases, some slight, some dangerous, have their beginning in the nose or throat.

Therefore, an irritated throat demands immediate attention. It may be the symptom of a cold—or worse. The germs causing the irritation must be killed before they get the upper hand.

Listerine, used full strength as a gargle, is a powerful aid in killing germs. Repeated tests by laboratories of national repute prove it. For example, Listerine full strength, in 15 seconds destroyed even the virulent *M. Aureus* (pus) and *B. Typhosus*

(typhoid) germs.

Yet Listerine is so gentle and safe it may be used undiluted in any cavity of the body.

Now you can understand why millions rely on Listerine to avoid ordinary sore throat and colds entirely, and to check them should they gain a throat hold. You'll be amazed to find how quickly Listerine brings relief.

If, however, a feeling of soreness persists, call your physician. It is no longer a matter with which an antiseptic can deal.

Keep a bottle of Listerine handy at home and in the office, and at the first sign of throat irritation gargle repeatedly with it full strength. Lambert Pharmaceutical Company, St. Louis, Mo., U.S.A.



Prevent a cold this way? *Certainly!*

Millions of ordinary colds start when germs, carried by the hands to the mouth on food, attack the mucous membrane. Being very delicate it allows germs foothold where they develop quickly unless steps are taken to render them harmless.

You can accomplish this by rinsing your hands with Listerine, as many physicians do, before each meal. Listerine, as shown before, is powerful against germs.

Use only a little Listerine for this purpose—and let it dry on the hands. This simple act may spare you a nasty siege with a mean cold.

It is particularly important that mothers preparing food for children remember this precaution.

LISTERINE

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His Salary Was Raised while others were reduced

"Up to the time I enrolled for a course with the International Correspondence Schools, I had only a grade-school education. Since enrolling, I have advanced to a much better position, where my salary is nearly four times as much as I was making previously. I would not be able to hold my present position had I not taken your course. Recently I received a nice increase in salary, while other men were being reduced."

READ that last sentence again—"Recently I received a nice increase in salary, while other men were being reduced."

There could be no better proof of the value of an I. C. S. course than that. It shows that the trained man is given preference over all others and paid more money, even in slack times, if his work deserves it. It shows that there are always bigger, better jobs open for men who have the foresight to prepare for them in spare time.

Jesse G. Vincent was a toolmaker before he enrolled with the I. C. S. He is now Vice-president of the Packard Motor Car Co. Walter Chrysler, President of the Chrysler Corporation, is also a former I. C. S. student. So is "Eddie" Rickenbacker, the famous flying ace, who is now Vice-president of the Rickenbacker Motor Car Co.

An I. C. S. course enabled Fred W. Southworth to leave a poorly paying job he had held for twenty years and get a position as a salesman. In six months he increased his salary 300%.

George A. Griebel is another man who lifted himself out of the rut by spare-time study. He was a stone-cutter earning \$15 a week when he enrolled with the I. C. S. He now has his own architectural and engineering business in Cleveland and his income is "between \$10,000 and \$15,000 a year."

If the I. C. S. can help these

men to get out of the rut and make good, it can help you too. If it can raise the salaries of other men, it can raise yours! At least find out how.

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Help for You in Building

ARE you thinking about building a house or modernizing your present home? If you are, you are in for a thrilling time if you take advantage, as you should, of the advances that have been made in the science of building in the last few years. There are today many new products and new methods that you should know about before you build. Some will make for comfort, some for economy, and some for beauty.

How are you going to learn about these wonderful new things and decide which ones you should determine upon for your new house or your remodeled home? The answer is the new Building Service of the Popular Science Institute, which is now available to our readers.

The information that the Popular Science Institute has collected in your interest in connection with modern advances in home building has been obtained from every possible source where correct information could be secured. In many cases where there has been a difference of opinion in the value of a certain type of product, thousands of architects and building contractors all over the country have been consulted. Popular Science Institute has established in its building service a clearing house for facts and information such as exists nowhere else in the world and which will be of immense value to you or to every reader of this magazine who is planning to build or modernize a house.

The Institute Building Service is not intended to take the place of the architect, the building contractor, nor any other essential factor in the building of a good home; its aim is to guide the man who is building a house and supply him with the sort of information that will enable him to make intelligent decisions as to what he will have in his house. The Institute is committed to the use of better materials, better methods of construction, and modern equipment—even when a greater initial expense may be involved—provid-

ing it is convinced real satisfaction and economy will result, justifying their use.

You live now in a house that is heated in some way in winter (unless you live in the far South). Do you know how much of that heat is wasted, how much fuel you could save if the house were protected by one of the modern insulating materials? Do you know that immense improvements have been made in heating systems and the wonderful convenience and economy that these modern heating systems offer? Before you build you should decide what kind of furnace you need; what kind of fuel you want, and what kind of heating system it is you should have. There is much that you should know about outside materials; about roofing materials, in which immense progress has been made and in which lovely effects can be obtained inexpensively. You should know the way that walls can be put up very inexpensively now, if one wishes to do it, and you should know the latest improvements in flooring materials.

AND, too, there has been great progress in the matter of windows, in plumbing, and in refrigeration, and lighting is now a science that you should give thought to before your lighting system is installed. If you are living in an old-fashioned house, even though it may have been built many years ago at a time when everybody thinks of building as having been very substantial, you will probably find that cold air seeps in from a dozen points; through the floors, through the walls, through the attic, all of which makes it almost impossible to keep the house warm at any cost.

Whether you are planning to build in the near future or not, you will be immensely interested in the series of articles that will appear in the coming issues of POPULAR SCIENCE MONTHLY. These articles are the result of reports secured in connection with every line of building

material, and check-ups made with thousands of leading builders and architects, together with information obtained from Government bureaus at Washington.

In questioning leading building contractors and architects regarding such modern features as insulation, scientific heating, new building products etc., the Popular Science Institute has found that practically every one of these alert men was most anxious to know what the consensus of opinion of his colleagues was on the same subject. If the information gathered by the Building Service of the Popular Science Institute is of value to these authorities on building, it will be doubly valuable to the amateur builder.

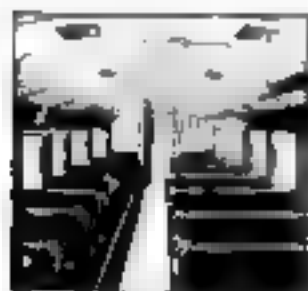
TWO things that you naturally want your house to have are the greatest amount of comfort and the most economical operation possible. These things you can secure through the advice of the Building Service of the Popular Science Institute, based on careful, exhaustive research it has made on these subjects.

The Advisory Board of the Popular Science Institute Building Service is headed by Prof. Collins P. Bliss, Associate Dean of the College of Engineering, New York University. Working with him are William Dewey Foster, Practicing Architect in New York City and a recognized authority on the building of houses, together with George Allen Richardson, President of Geo. Allen Richardson, Inc., Engineers and Contractors, and also Construction Superintendent of the Eastern States Construction Co. The building articles to appear in POPULAR SCIENCE MONTHLY will be written by experts and the new service will be in their charge.

This Service is available to every reader of POPULAR SCIENCE MONTHLY, free of charge. Address questions relating to building materials and equipment to the Popular Science Institute Building Service, 250 Fourth Ave., New York.

Manufacturers and inventors use this grainless wood to make good products better

The making of broad pieces, peculiar shapes and curved surfaces often makes it difficult to obtain low cost production. But Masonite Presdwood solves these trying problems. This grainless wood is readily cut, sanded, punched, or curved. It resists moisture and takes any finish. Write for a generous sample. Then try it for yourself.



FOR RAILROAD COACH
CEILING

Reports of new uses for this grainless wood are coming in daily. A manufacturer solves a production problem, cuts costs or widens his market. A mechanic develops new ways of working and finishing it.

An inventor finds it meets requirements better than any other material. And—three years after placing Masonite Presdwood on the market—we, who make and sell it, are still wondering just how far its range of usefulness will finally extend.

Builders of fast motor boats and outboard hydroplanes say that Presdwood gives their craft lightness, strength and speed. Contractors use it for concrete forms because the resulting smooth surfaces cut their labor costs to the bone. And from far and near come orders from makers of road signs who wish to take advantage of Presdwood because it is easily worked and quickly painted.

Presdwood IS wood

Presdwood is made of wood—exploded to separate the fibres—then formed, with heat and enormous pressures, into uniform boards, $\frac{1}{8}$ inch thick, four feet wide and twelve feet long. The same wood binder (the lignine) that held the wood fibres together, again cements the fibres of

Presdwood, but now there are no knots, no grain, and no cracking, checking or splitting to mar the beauty of the finished product, or worry the manufacturer.

Where broad surfaces, beautifully finished, are essential—there you will find Presdwood. It is used in paneled walls of apartments and office buildings. It is used for broad side panels of motor truck bodies and the interiors of Pullman cars. And in the moving picture studios of Hollywood it is artistically employed to portray the ballrooms of the rich and the palaces of kings.

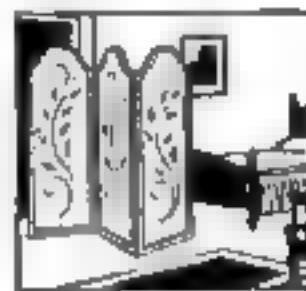
Does not warp—resists moisture

Because of its freedom from warping and buckling, and because of its resistance to moisture, we find Presdwood used for the tension boards of radio loud speakers, for bedroom screens, work bench tops, campers' tables, bread boxes, dairy product containers and starch trays for candy factories.

And when you try Presdwood for yourself, you will find that it will solve a manufacturing problem, reduce costs or make a good product even better. Write for a large free sample. It will be sent promptly on request.

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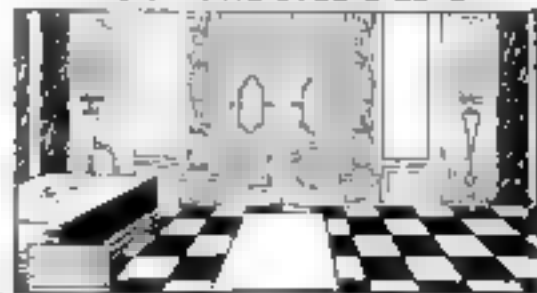
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Our Readers Say—



Eyeglasses a Fad?

I WAS amazed that either POPULAR SCIENCE MONTHLY or Dr. Free, whose articles I usually read with interest, should fall so hard for the propaganda of oculists and opticians as to publish that article, 'Must We All Wear Glasses?'

"What we need is not more glasses, but fewer glasses. Having eyes examined has become as much of a fad as removing tonsils and a few years ago cutting out appendices. Indeed, I am convinced that the style of wearing specs, far from being a remedy, is one of the chief causes of America's failing eyesight."

"Take my own case. Three years ago my vision seemed perfect, I found no trouble reading anything and everything. But, being confined to close office work, my eyes would feel tired at the end of the day."

A friend advised me to consult an eye specialist and, of course, he prescribed glasses. The only difference I noticed was that the lenses slightly magnified. But, after wearing them a few weeks, I found I had become their slave. If I tried to read without them, a headache was sure to follow. The only result of glasses for me was weakened eyes, and the only profits went to 'specialists' who designed and made them."—A. R., Chicago, Ill.



It Rained Salt Water!

WITH reference to a recent item on waterspouts in your magazine, I would like to add what seems to me to be an important correction to the statement that ocean waterspouts are not salty.

"Several cases are on record in our files of waterspouts that unquestionably carried sea water. Weather reports from seamen have told of salty spray being thrown on deck by passing spouts, and have mentioned the fall of salty rains from spout-bearing clouds."

"About two hours after the disappearance of the famous waterspout of August 19, 1896, off Martha's Vineyard, residents of the island were astonished by the singular fall of rain which they said was salt to the taste. The spout had an estimated altitude of 3,000 feet, and a quantity of sea water had been drawn to such a height and distributed about in the attendant cloud mass to such a degree as to affect the freshness of the rainfall."

"Now, while the greater portion of the ordinary funnel is undoubtedly composed of ordinary cloud matter—a condensation product—yet in local ocean whirls of great intensity it should be no more surprising that some sea water may be caught up and borne aloft, than that tornadoes on land should pick up wreckage, carry it to a great height, and bear it to some distance from its place of origin."—W. E. H., Weather Bureau, Washington, D. C.

Thanks, Doctor

"WITH your recent article, 'A Mystery of the Blood Solved,' was a diagrammatic drawing of the heart and the circulatory system. Out of thousands of drawings I have seen and

studied mostly in medical journals, and occasionally in lay journals, this drawing is by far the best. It is even instructive to me, who has dissected many hearts and examined thousands of patients for possible heart disease."—Dr. J. E. E., Grand Forks, N. D.

Airplanes and Death



"I READ with some amusement the satiric letter 'from a hero worshiper,' in which E. T. H., Jr., inferred that the Wright brothers, by inventing the airplane, landed upon the world an evil machine of death. And it occurred to me that if the writer instead of railing about bloody Sundays in the air, would take the trouble to learn the facts, his fears might be relieved."

"A recent official report of airplane accidents during the first six months of last year lists 300 mishaps, in which 155 persons were killed and 276 injured. At first glance this would seem a heavy toll, until we read further that in scheduled flying over established air routes, there were only six fatal accidents. The great proportion of fatalities occurred in 'miscellaneous flying'—races and other contests, ocean flying, and experimental flying."

"And the airplane casualty list grows even less imposing when we turn to another report, recently issued by Louis I. Dublin, statistician of the Metropolitan Life Insurance Company. It shows that in the supposed security of American homes, 25,000 men, women, and children were killed by accidents during 1927! Of these 2,750 were killed by falls."

"I don't contend that the airplane is fool-proof. But compared with the hazards that surround us every moment, airplanes offer little to fear."—H. N. P., Detroit, Mich.

Good Enough to Fly

"I WISH to compliment the artist who painted the picture for your December number on his ability to picture mechanical devices. The plane is one that any pilot would be glad of the opportunity to fly. It would be my suggestion, however, that before the pilot of this particular plane revs up his motor very fast, he have his mechanic change the propeller. It would be hard to my just what to expect if the present one were left on the motor. At least he couldn't expect to gather much headway."—L. B., Urbana, Ill.

Saved Their Money

"I READ with profit Alexander Schaulke's article about the new radio kips and their trick serials. My receiving set is bearing completion, and I was about to send for a certain underground serial. In this letter I hope to express my gratitude to your magazine for good advice. I believe I am one of thousands that profit by the 'Institute of Standards.'"



R. S., Hastings, Mich.

"Today I received a letter soliciting my order for an underground antenna. Thanks to your experiment, I can keep five dollars or thereabouts for something else."—Mack obaged O. E. W., Chicago, Ill.

More about Gliders

I NOTICE in POPULAR SCIENCE MONTHLY that there is added interest in flying, stimulated by those jolly Germans at Cape Cod, as I want to have my say.

"From a major in the U. S. Army Air Corps, who was sent to Germany to study gliders, I find that a good safe glider can be built for \$50 to \$75, that, for a little more, they can be made to carry a passenger. They can be launched by elastic devices, catapults, or down inclines, or by being pulled by a few bicycles, a motorcycle, or an auto. They will take off certainly at thirty miles an hour."

"A glider pilot is an airplane pilot, but an airplane pilot is not a glider pilot. From the Department of Commerce, I found that gliders must be licensed like planes, but the pilots need not be. To quote the man who told me that: 'There is only the law of self-preservation applying to pilots of unmotORIZED aircraft.'"

—J. B. R., New York City.



What Do You Say?

PLEASE tell me what, in your opinion, is the world's greatest invention. Is it the lever, which has made possible modern machinery? The bow and arrow, which freed man from the tyranny of wild beasts and gave him time to think? Or the printing press, which made education possible for everybody?—D. B. L., St. Louis, Mo.

In the Model Ship Yards

PERHAPS you may be interested in hearing of my toy motor boat, built from your blueprints numbers sixty-three and sixty-four. The International Rotary Club of Nashville holds a Boys' Hobby Fair annually. I entered my boat as an individual exhibit and received the Grand Award. I am interested in boat building of all kinds, and turn first to the pages in POPULAR SCIENCE MONTHLY that carry this kind of news."

B. C. K., Nashville, Tenn.

"I have built all of the ship models described by Capt. McCann except the one of the Constitution. In my opinion, the Mayflower is the most beautiful and satisfactory of them all. And I can imagine no more fascinating hobby for anyone. Your blueprints are superior to any I have ever found."—H. F. O., Maasillon, O.

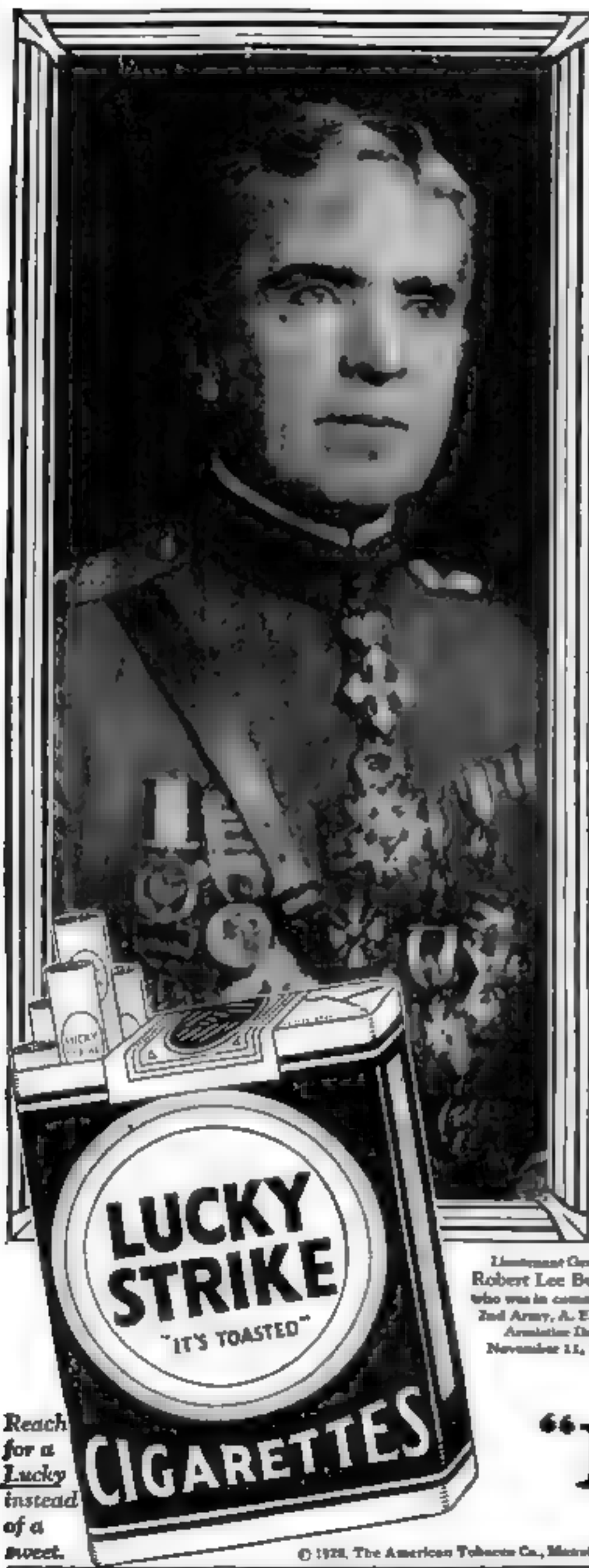


Kind Words from Friends

WHEN I first started taking POPULAR SCIENCE I wondered why you didn't make a weekly out of it, but it didn't take me long to find I couldn't absorb all of it. I wanted to in a month."—C. A. S., Springfield, Mo.

"I have missed the trolley car and been late to school, but I have never, since I first saw your magazine, missed an issue."—E. A. C., Burlingame, Calif.

"I am a home worker with shop in basement, and could not get along without POPULAR SCIENCE."—J. W., Laramie, Wyo.



Lieutenant General
Robert Lee Bullard,
who was in command of
2nd Army, A. E. F. at
Armistice Day,
November 11, 1918

"An army man must keep fit - reach for a *Lucky* instead of a sweet"

Robert Lee Bullard

Lieutenant General
Robert Lee Bullard

"General de Branch, one of Napoleon's greatest cavalry leaders, said: 'Smoke yourself and teach your men to smoke. It will comfort you and them under the greatest strain.' One hundred years after de Branch, one million Americans fighting at the front in France and smoking *Lucky Strikes* found it to be true. Of course, I say reach for a *Lucky* instead of a sweet. An army man must besides keep fit and not be overweight."

The modern common sense way—reach for a *Lucky* instead of a fattening sweet. Everyone is doing it—men keep healthy and fit, women retain a trim figure.

Lucky Strike, the finest tobacco, skillfully blended, then toasted to develop a flavor which is a delightful alternative for that craving for fattening sweets.

Toasting frees *Lucky Strike* from impurities. 20,679 physicians recognize this when they say *Luckies* are less irritating than other cigarettes. Athletes, who must keep fit, testify that *Luckies* do not harm their wind nor physical condition. That's why *Luckies* have always been the favorite of those men who want to keep in tip-top shape and realize the danger of overweight. That's why folks say "It's good to smoke *Luckies*."

A reasonable proportion of sugar in the diet is recommended, but the authorities are overwhelming that too many fattening sweets are harmful and that too many such are eaten by the American people. So, for moderation's sake we say—

"REACH FOR A *LUCKY*
INSTEAD OF A SWEET."

"It's toasted"

No Throat Irritation—No Cough.



Who wants a *heat-leaking* house?

A GREAT change has taken place in home construction.

Progressive building authorities and home owners are replacing old-fashioned, heat-leaking materials with a remarkable insulating cane board—Celotex.

In old homes and new Celotex *increases comfort* by shutting out extreme winter cold and summer heat.

It *protects health* by guarding your family against dampness, chills and draughts.

It *reduces fuel bills* 25% or more

by retarding heat-leakage through walls and roofs.

As a heat-stopper, Celotex has a value 3 times that of wood, 8 times that of plasterboard, 12 times that of brick and 25 times that of concrete.

Its effectiveness is proven by the fact that it is used in thousands of refrigerator cars and household refrigerators, as well as in nearly a quarter of a million American homes.

Celotex is used for sheathing; for insulating roofs and for lining base-

ments, attics, and garages. And for plaster-base there is Celotex Lath, especially designed to eliminate cracks and lath marks.

Ask any building authority for further information on Celotex—and send in the coupon below for our free booklet.

The Celotex Company, Chicago, Illinois. In Canada: Alexander Murray & Co., Ltd., Montreal. All reliable dealers can supply Celotex Standard Building Board and Celotex Lath.

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When you buy a new house look for the Celotex Sign. It is your assurance of greater home comfort

The word
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Please send me free your illustrated booklet, "Year Round Comfort and Fuel Saving for Every Home."

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Address _____

City _____ State _____



COAL *from* CABBAGES



By employing fibers for use in the manufacture of the only way from the cotton plant and to wool.

A small machine, Dr. Bergius has found, will make synthetic rubber from coal.



With nothing of them worth the price of wood, it is well to see that they have some length of life.



And food from sawdust, lemonade from peanut shells, lumber from straw, cotton from banana stalks! More amazing than a fairy tale is this story of chemistry's latest magic. Here are adventure, wonder and romance right at your door

By GROVER C. MUELLER

ON THE speaker's platform in the auditorium of the Carnegie Institute of Technology at Pittsburgh some weeks ago, an unassuming man, hailing from romantic old Heidelberg, the famous university town in Germany, stood and announced in matter-of-fact tones that after twenty-two years of experimentation, he had succeeded in making coal out of wood, cabbages, and cornstalks!

His low-voiced, undramatic reading of a highly technical paper was followed by an ovation from an otherwise austere and undemonstrative gathering of distinguished scientists from many lands, who were attending the second International Conference on Bituminous Coal.

Dr. Friedrich Bergius, the speaker, had taken eleven pounds of cellulose, a chemical derived from various plant and vege-

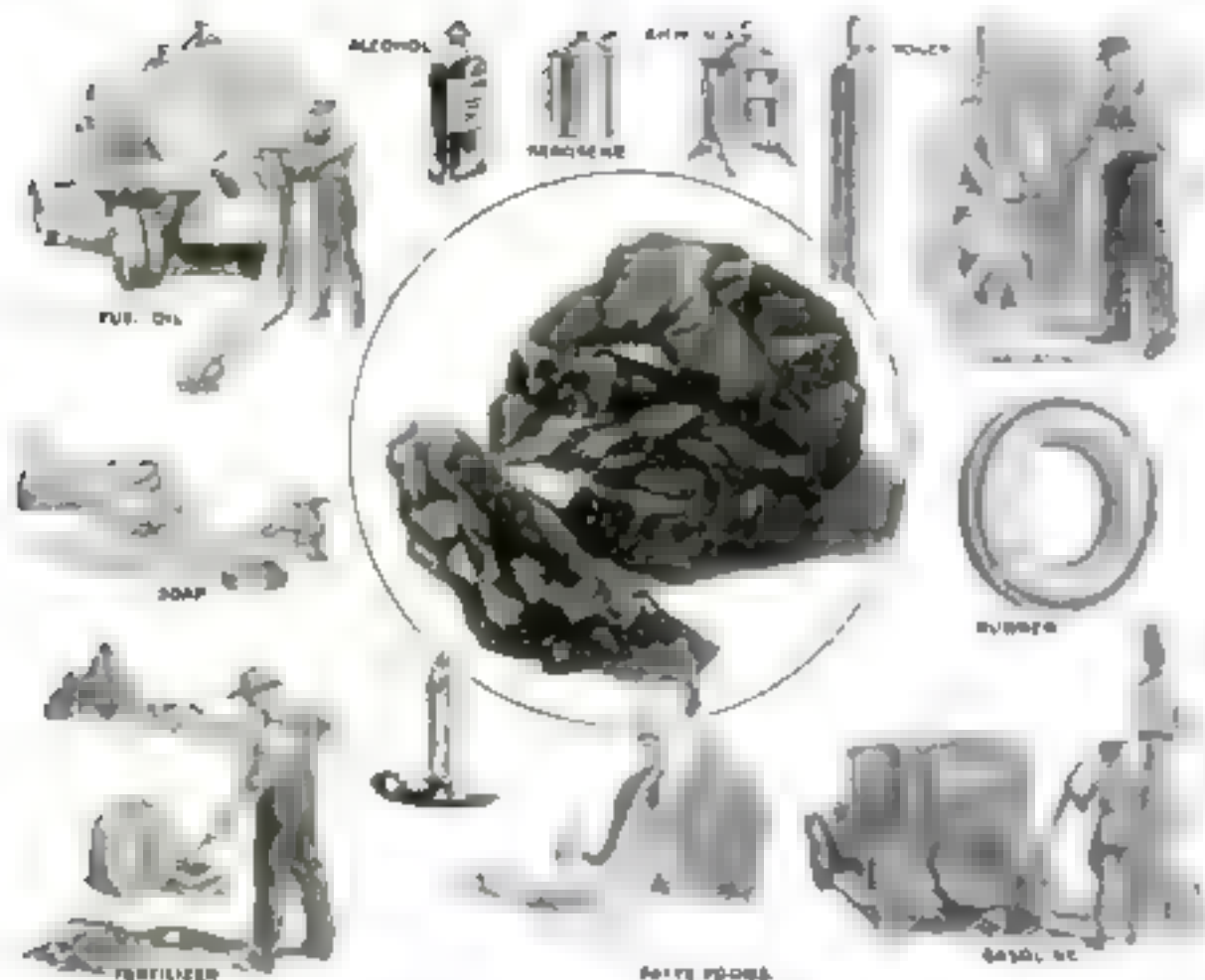
table substances, mixed it thoroughly with water, and placed his solution in an air-tight vessel. Then he had heated it to 840 degrees F. and put the container in molten lead. After allowing this sealed cooking to continue for twenty-four hours, he had shut off the terrific heat, let the accumulated gas escape from the vessel, and waited for the liquid to condense. Result: eleven pounds of coal!

But in a broader sense, Dr. Bergius had done much more than that. He had leaped across the chasm of the ages and, in twenty-four hours, produced an indispensable substance which it takes nature twenty-four hundred centuries to create! Overnight, he had challenged her seemingly immutable laws with an invention which may avert fuel famine for untold future generations.

At the same conference, Dr. Carl

Krauch, director of the German Dye Trust, fascinated the delegates with a description of the making and marketing of synthetic gasoline, obtained from soft coal. This year a production of 70,000 tons was reached by the plant of the trust at Leuna; next year, an output of 250,000 tons may be attained.

FROM a business and scientific point of view, this is what happened. There was a shortage of oil in Germany, the price of the fuel had become exorbitant. Chemists of the nation set to work and turned coal into oil by various methods. In a way, it was a duplication of what Germany did during the World War, when, with oil supplies cut off by a ring of warships, German chemists reached into the sky to take out of the atmosphere the artificial ammonia which had hitherto



Here are just a few of the important articles in common use which now can be made from coal and its by-products by the magic of chemistry. Dyes, perfumes, even wax, are among others on the list.

been imported, in the form of nitrates, from Chile.

But think of the deeper significance of this synthetic oil discovery! Consider its effects upon international relations and the peace and prosperity of mankind! What these chemists in their laboratories really did was to take the germs of another world war, put them in the test tube, and dissolve them out of existence! The conflict they averted was the giant struggle over the diminishing supply of the world's natural petroleum, which the great powers were supposed by some observers to be preparing. While demands for oil are growing by leaps and bounds, the available supply gives no promise of lasting longer than until the end of this century. And so, the pessimistic prophets of international rivalry predicted, there was no other way out for the nations but to engage in a death-grapple for the control of the precious liquid.

NO SOONER had Dr. Krauch finished his address, than F. X. Zur Nedden, secretary of the fuel committee of the national council of Berlin, told the assemblage of the vast economic advantages of the use of coal liquefied by a process of distillation! This method not only tends to diminish the importance of the earth's slowly vanishing coal supply, but it does away with the cumbersome weight and the ballast of ash and humidity inherent in the fuel's present form.

And another German scientist, Dr. Fritz Hofmann, revealed that he had produced rubber from coal in his laboratory. For the time being, he explained, the synthetic product is more expensive than natural rubber, but he is hopeful, through future experiments, of making artificial rubber on a large commercial scale.

Thus the conference presented an array of amazing discoveries showing that the dreams of the scientist are being turned into actualities that are bound to change the complexion of business and industry and make their benefits felt in the homes and daily lives of millions of men and women the world over.

Not only oil from coal and coal from oil, coal from cabbages and rubber from coal, but burnable gas from water, wood alcohol from coal, soap from coal, and even edible fats from coal—the day of synthetic bacon may soon be upon us!—were among the completed achievements or promising potentialities the scientists



Artificial silk from peanut shells! Dr. E. J. Lynch, of the U. S. Waste Utilization Service, demonstrates here how it is done.

at the convention had added to the wonders of modern chemical industry. That industry now produces coke more useful than raw coal, dyes in colors more dazzling than the rainbow, perfumes more fragrant than flowers, and many other artificial articles that surpass Nature's own handiwork in providing humanity with comfort and pleasure.

SHORTLY before the conference in Pittsburgh convened, Dr. A. O. Jaeger, an American chemist, announced two new processes, involving the purification of anthracene, that will give the dye industry in this country an untold wealth of raw material now locked away in the black heart of coke and coal tar.

About the same time C. H. McDowell, president of the Armour Fertilizer Company of Chicago, disclosed the invention of a method of extracting fertilizer from coal which will prove invaluable to our farmers in the raising of corn, winter wheat, and cotton. The plant food was discovered as a by-product when ammonia was eliminated from illuminating gas to obviate its unpleasant odor.

A few weeks previous, two German chemists triumphantly informed the world that, after years of fruitless attempts, they had succeeded in making food out of wood, or, to be specific, sugar out of sawdust! And on the heels of this announcement came the still more astonishing news from France that a scientist there had transformed coal into diamonds which, ere long, may grace the throats and hands of our American beauties!

This series of scientific events once more threw into bold relief the fact that the chemist has not only inherited the cloak and improved upon the arts of the alchemist of medieval times, but that he is the modern counterpart of the magician of the dark ages—the Merlin at the court of the Average Man, who is king in our day of democracy.

BUT unlike the practitioner of "black magic" centuries ago, the present wonder-worker does not aim to mystify and to bewitch his fellow men. On the contrary, it is his purpose to clarify for them the blind and seemingly inscrutable forces that surround them on every hand in Nature, and to enslave these powers for their greater happiness and well-being.

The day is coming, has, in fact, arrived—when the chemist feeds us, clothes us, heats and lights our houses, and supplies essential fuel for the machines that transport us and make our daily necessities.

Coincident with the news that scientists had managed to turn sawdust into food, came the report that a German chemical laboratory was beginning to turn out clothing made from aluminum in thin sheets to take the place of wool and cotton. And Dr. Warren E. Emley, of the United States Bureau

Chemical
Engineering
and
Technology

WOODS
FARM
SAWDUST
FED PORK



of Standards, told a meeting of members of the American Chemical Society recently that a lemonade made out of peanut shells and bran would soon be ready for commerce and consumption. One of the details that await further perfection is the name of the beverage, which at present, for lack of something shorter and prettier, is called "xylotrihydroxyglutaric acid"! But what's in a name?

HUNDREDS of other chemists throughout the world are engaged in transmuting waste into matter useful to mankind. They, too, are magicians of modern science. A young Philippine chemist by the name of Balinas not long ago invented a substitute for cotton fiber which he produced from hitherto worthless banana stalks! The process, resembling mercerization, consists of "cracking" off the cellulose binding of the fiber, which leaves it pure white and ready for weaving without having to be spun first.

Large quantities of straw in the cereal regions of our Middle West, where there are no forests, are being turned into material for insulating building boards. Its fibers are cemented together in long filaments.

In the laboratory of the U. S. Bureau of Mines at Pittsburgh more than three gallons of wax recently were extracted from one ton of Utah coal! First, thirty-two gallons of tar were taken from the coal, and further experiments made the tar yield eleven percent of wax. The

chemists who made the discovery declared that great quantities of wax, in no way inferior to the stuff now used in candles, may be produced from tar with little effort.

A little bird literally told English research workers in British Guiana how to obtain a substitute for cotton from a useless plant. This feathered fellow was seen building his nest with materials that looked like cotton, but which proved to be another plant stripped and treated by the bird.

The investigators brought the seed and roots to England. That was eight years ago. Now, between three and four million pounds of this artificial cotton is being grown on soil in Essex and Sussex counties that had been considered of no use for any sort of vegetation. And not only has the ground been put to good use, but the substitute cotton, which is said to be as good as the real article, is eight cents a pound cheaper.

THE transmutation of sawdust into food—one of the most striking examples of utilizing waste material—was accomplished by the simple process of adding one molecule of water to one molecule of cellulose, which with lignin is a principal constituent of wood. This chemical reaction had been known for more than a century, but until the two German scientists thought of it, the idea that, in this fashion, the enormous amount of waste wood contained in sawdust—about forty percent!—could be turned into food for animals and, eventually perhaps, for men, too, had never occurred to anyone.

Only very recently, modern alchemists of chemistry discovered that seaweed could be turned into good—but of course, presently, on the Pacific Coast, a great seaweed industry has lately developed. It was

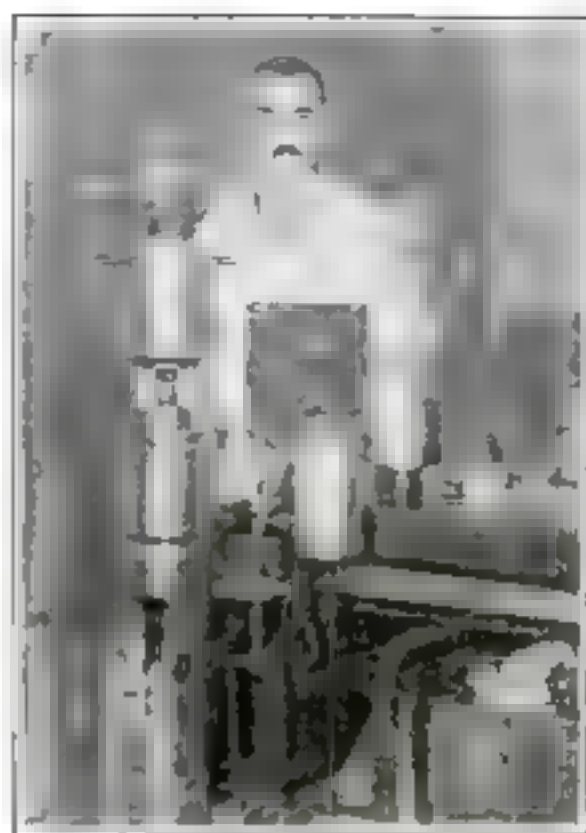
Lemonade made from peanut shells and bran soon may be a popular beverage. For this we have the word of Dr. Warren E. Emley, of the United States Bureau of Standards, shown at left.



Oil from coal and coal from oil—coal from cabbages and rubber from coal! New marvels spring from the chemists' magic crucibles.



By brewing cellulose taken from wood, cabbages, and cartastella, Dr. Friedrich Bergius, of Heidelberg, Germany produces coal. This photo shows him in laboratory with jar of the synthetic fuel.



James Basset, French chemist, and apparatus with which he claims to make diamonds by subjecting coal to great pressure.

discovered that this "worthless" plant contained properties similar to starch and gum arabic—in fact, it is superior to both, as it has fourteen times the stickiness of starch and thirty-seven times that of gum arabic. It "fills" cloth better than starch and leaves it thick and elastic instead of stiff. Chemists predict that it also will prove highly useful in dyeing and color-printing and that, before long, we may even eat it, mixed with certain other foods!

THUS, in a hundred experimental laboratories, chemists are finding ways of utilizing the things which we now throw away. And yet—curiously enough—the waste piles of the world continue to grow larger. Why? The answer is that there is more to the problem of utilizing waste than finding how to make it into something useful. There is the problem of transporting the waste to the factory, or the product to its ultimate market.

It is, of course, of not much use to spend time and money in reclaiming waste until there is a market for the reclaimed product which can be reached at a cost which will yield a profit. The new straw lumber developed in the Middle West, for example, is intended for use only in the treeless wheat country, where ordinary lumber has to be brought from a distance at great expense. But the product of the straw stacks cannot pay transportation charges to distant markets, even if it could compete with wood in markets where lumber is cheap.

Scientists, as a rule, are not business men and, fortunately for the sake of humanity, they persist in their investigations and laboratory experiments regardless of possible commercial obstacles. An ideal condition, of course, would be the utmost cooperation between chemistry and industry. And this is now coming to pass. Day by day, natural science and business are being linked more closely together. In this way, an invisible bridge is built that connects the wonderful dream-world of the laboratory with the living reality of your home and mine!

Building the Greatest Bridge



The Story of One of the World's Most Thrilling Engineering Feats—Giant New Hudson Span Will Carry a City in a Day!

By EDWIN KETCHUM

IMAGINE all of the men, women, and children of Baltimore, Md., leaving their houses on a sultry August morning and piling into automobiles to rush away from the heat of the city.

Then picture this huge procession of automobiles,—about 200,000 cars in a line that would reach two thirds of the way from New York to Chicago!—passing in that one day across a suspension bridge of a single span 3,500 feet long, and you have gained an idea of the tremendous traffic to be borne on a summer Saturday by the greatest bridge in the world.

Realize, next, that all of these cars with their four fifths of a million passengers, besides hundreds of buses and electric trains, thousands of pedestrians, and the mammoth weight of the bridge itself, will be supported by four cables over a distance of fourteen city blocks, 200 feet above the water, and you have a conception of the boldness and magnitude of one of the most wonderful engineering feats ever attempted.

But such a giant bridge does not exist, you say. True! It will, however, be a monumental reality within a few years. In 1932, the new Hudson River bridge, dwarfing all other structures of its kind, will stretch across the Hudson from Fort Washington, in New York City, to Fort Lee, in New Jersey, giving New York a great new gateway to every part of the United States.

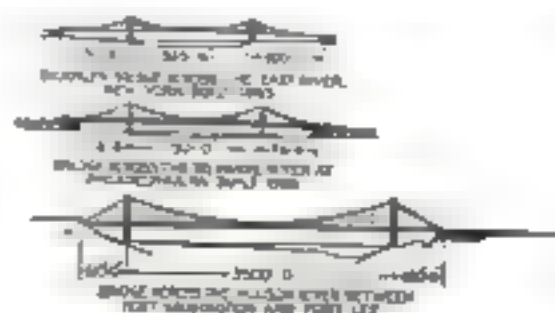
The main span of this titan among bridges will be twice as long as that of the 1,750-foot Philadelphia-Camden crossing which, since its opening in 1926, has held the record of being the world's longest suspension span. And the famous Brook-

lyn Bridge, with its 1,595 feet, will seem almost insignificant beside it.

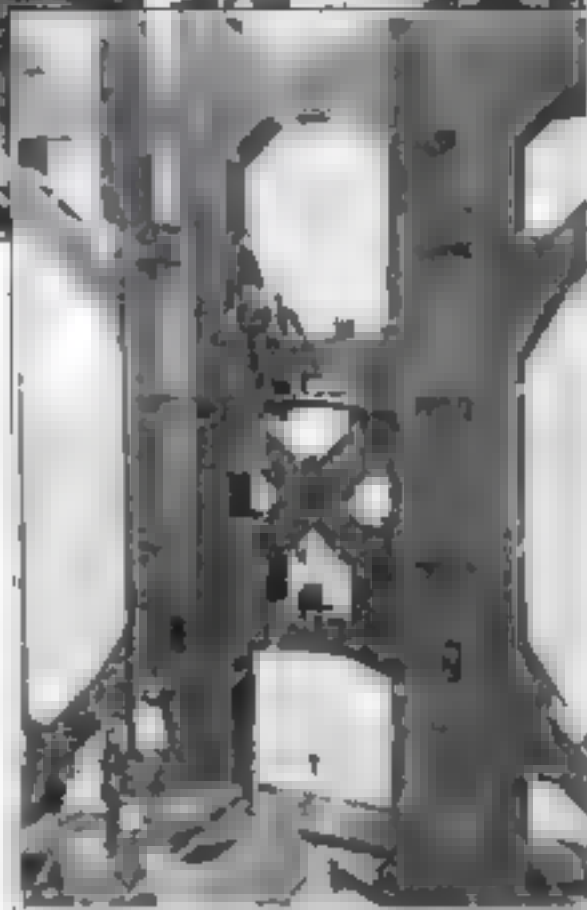
Fourteen traffic lanes, including eight roadways, two sidewalks, and four electric railway tracks, will accommodate its unprecedented traffic. It is expected that 40,000,000 automobiles will eventually cross it in a year! Its total cost will reach \$40,000,000.

The height of its finished cable towers—635 feet—will exceed that of the Washington Monument by eighty feet and that of the Singer Building, in New York, by twenty-three feet. They will hold a 90,000-ton fabric of steel and concrete in mid-air—twice the weight of the steamship *Lerionan*! The carrying cables will have a capacity of 350,000 tons, compared with 120,000 tons for the cables of the Delaware Bridge and 45,000 tons for those of the Brooklyn Bridge.

It is estimated that in the first year of operation 8,148,000 vehicles, containing some 19,000,000 passengers, will move across the new span, in addition to 1,500,



This comparison gives an idea of the gigantic proportions of the new Hudson suspension bridge. Its central span will be twice as long as that of the record-breaking Philadelphia-Camden bridge across the Delaware. And it will dwarf the once famous Brooklyn Bridge.



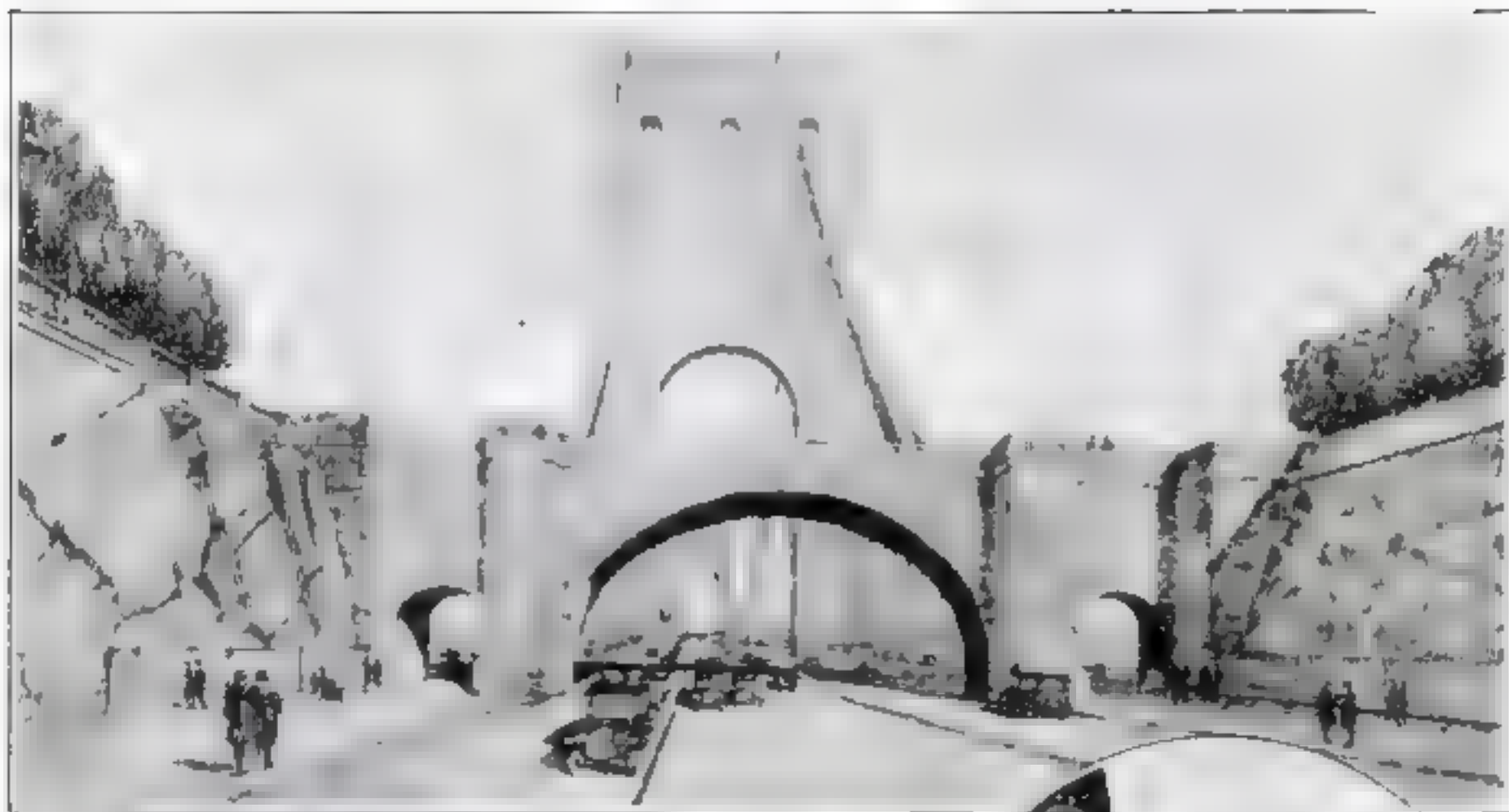
Rearing huge cable tower on the New York shore. The towers rise 635 feet—eighty feet higher than the Washington Monument. Top: How the new Hudson span will appear when completed. Dark portions are already built.

000 pedestrians and nearly half a million buses!

The magnificent structure, when completed in 1932, will have been made possible through the unique engineering undertaking of deep-rock mining operations on one shore, and erecting a man-made mountain range on the other. For the engineers were confronted with the problem of anchoring it in the solid rock of the Palisades that rise on the Jersey bank of the river, and of constructing a huge cliff on the New York side to match the natural stone opposite in everlasting power.

BEGIN in the summer of 1927, the work of construction is proceeding rapidly. Near the Palisades Amusement Park, on the Jersey shore, where young New Yorkers ride the scenic railways in search of artificial thrills, a mighty, stirring drama is staged daily with virtually no audience.

Building the huge cable towers that already have passed the 500-foot mark—which means (Continued on page 144)



The spanning approach to the Hudson River bridge on the New York side will look like an island. Here the huge concrete piers will be anchored into the rock. Right in the middle of the river, the bridge will span the Hudson River in a single busy day.



Tower and approach on the New York side as they will appear from the river. Tower contains 10,000 tons of steel.

Right: At dizzy heights above city roofs the bridge workers balance off narrow steel beams.



No dare for weaklings. Kittinging tight net continuous steel girders 500 feet above the Hudson.



Below: Constructing concrete anchorage of the bridge cables on the New York side. This massive concrete covers almost a city block and is as high as a fourteen-story building.



Giant fingers of steel begin to reach across the river. It's a thrilling job and one of the mightiest engineering feats ever attempted. This photograph gives an idea of the tremendous size of the girders used in the construction of towers that will hold a ninety thousand ton fabric of steel and concrete in mid air above the mighty Hudson River.



Snuffing Out a Giant Candle

Fire Fighters, Behind Shields of Steel, Win Terrific Battle with a Flaming Oil Gusher

By
JOHN E. LODGE

SOOT-SMEARED, an oil driller races across the sand. His face is distorted with fear, his undershirt scorched. Behind him, amid a cluster of twenty oil derricks like ant hills on a desert plain, a pillar of flame shoots skyward. One of the towers rises bodily into the air, and is hurled in a dozen directions. A deep, rumbling crash, as in the ground under his feet quivers like jelly.

That was the scene when Belvue No. 1 latent oil gusher in the rich Santa Fe Springs field near Los Angeles, Calif., "came in" the other day. When the drill point tapped an underground lake of oil, a column of the liquid spouted high in the air. Underground rocks came with it. A stone struck the casing. Sparks flew. In a second the gusher had become a 200-foot high candle of flaming oil. Near-by derricks toppled, weakened by the frightful heat. Engineers advanced into the black smoke clouds, under protecting water streams from hoses, to raise more derricks and check the million-dollar fire's spread.

How can one of these spouting infernos of liquid fire be extinguished? This was not the first time an untamed oil geyser has menaced its drillers with fire. Lightning has made oil derricks its target and turned productive wells into death traps. Sometimes a harmless-looking grass fire touches off a well. Whatever its cause, a flaming pillar of oil, hot enough to melt a derrick's steel, is not a pretty thing to put out. Yet engineers have dared to attack these fires, with sensational success. One of their recent triumphs, only enough, has been just half a mile from the scene of the latest oil fire, where a novel system of putting out an oil blaze received a spectacular demonstration.

For eight weeks a freak



A breath-taking moment during the Belvue No. 1 oil gusher fire. A huge derrick, weakened by terrific heat from the 200-foot pillar of flame, topples and crashes. Photo at left shows the five-ton steel cap which snuffed out a previous fire in the same field.



fire raged about what had once been the derrick of Getty No. 13, in the same Santa Fe Springs field. Dense smoke billowed from the flood of seething flaming oil, while above roared a smokeless jet of fiery

gas. Advancing behind steel shields to screen them from the heat, fire fighters approached the terrific blaze. After a brief perspiring survey they decided to

try a desperate experiment—to snuff it out, like a giant candle.

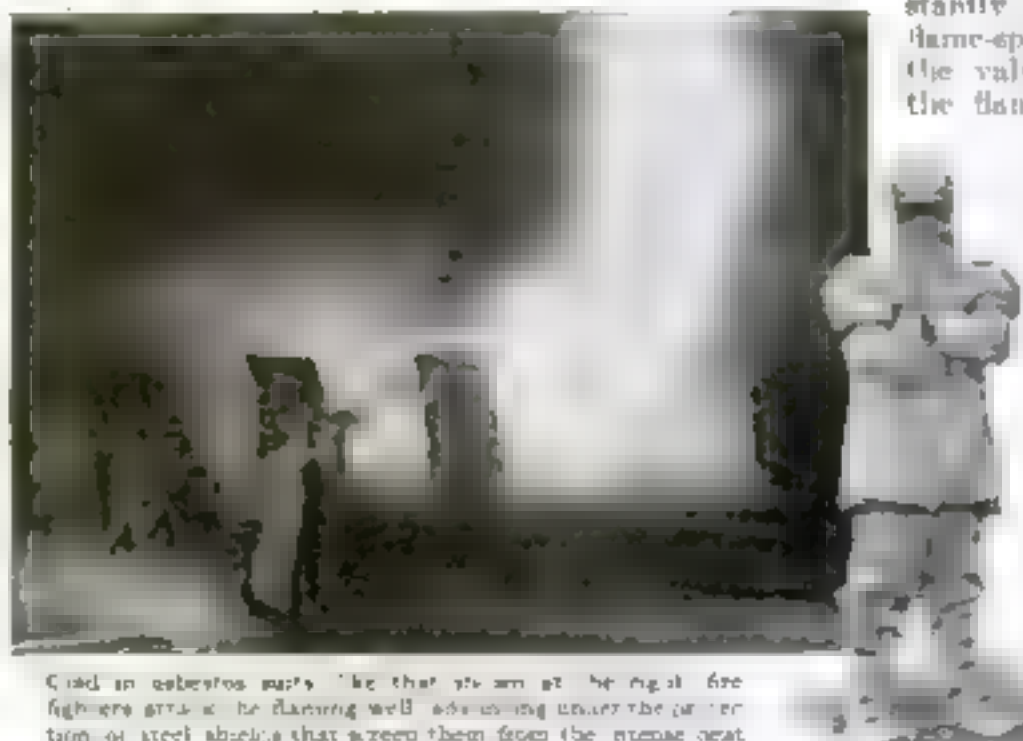
First, a sapping project reminiscent of those of the World War was carried out. Under cover of the shields, tunnelers burrowed into the earth and dug an underground shaft two hundred feet long to pierce the main casing. Through it, sixty feet beneath the ground, quantities of gas and oil were diverted and the force of the burning jet diminished enough for the daring attempt.

TO SNUFF out the "candle" the men chose a five-ton cap of steel that looks like an inverted funnel. Its top is a stack with a huge valve, while at the wide-mouthed base is another pipe, with a valve, to lead off unburned oil.

Tractors and a daring crew popped this cap over the burning well. Instantly the funnel stack became a flame-spouting chimney. A turn of the valve wheel in the stack, and the flames went out—the pipe was plugged and the fire smothered. A hoarse command, and the valve on the lower pipe was opened in time to save the whole five-ton cap from being blown off by the accumulated pressure. Harmless oil poured out into a pit.

The fire was out!

Often nitroglycerin is used by the asbestos-clad men who extinguish oil well fires. Charges of explosives dropped into the blaze and exploded literally blow the fire out.



Cold in asbestos suits like that you are at the right, fire fighters attack the flaming well, advancing under the protection of steel shields that screen them from the intense heat.



George Washington invented a plow that sowed grain and covered it with earth at one time.

By

HOMER CROY

FEBRUARY brings to mind that two Presidents, both born in the same month, were, in their own right, inventors. They are George Washington and Abraham Lincoln.

And in their inventions they showed their different natures.

We'll take Washington first because he came first. Washington was the richest man in America; a country gentleman. He had an unwavering passion for practical things. Figures and exact quantities especially appealed to him. Once he set two workmen on his estate to counting how many seeds were in a bushel of clover. It took days, and when it was finished he carefully made a note of it.

Washington, on account of his social position, entertained a great deal. At his dinners he always served wines. One day as the bottles were going around he noticed that there was some confusion as to which bottle was which and what was what. His practical mind immediately fastened on it; here was something that needed remedying. He invented a device holding four bottles and which could be passed around so that all the bottles came to a guest at the same time. From this he could make his choice. In his own words Washington said of the contrivance:

"It will be more convenient for passing the bottles from one to another than handling each bottle separately, by which it often happens that one bottle moves, another stops, and all are in confusion."

The idea was similar to a caster, or a cruet for condiments for the table, except that it was more elaborate. It consisted of a little platform mounted on wheels so that the device with its

to such an extent that no formal dinner was considered correct unless it had a Washington wine coaster plying up and down the festal board to serve diners with the wine of their choice.

A wine serving device! Can you imagine Abraham Lincoln—that simple, homely son of the soil—inventing such a thing?

What next did the industrious, practical, Washington make? This time it had to do with his estate. It was a plow. He had seen a plow which had been brought over from England, and immediately his practical mind worked out an improvement. Then he called Peter his smith, and set to work constructing it.

The plow, when finished, developed the curious eccentricity of not wanting to stay in the ground. Washington designed it

freight of wines could be rolled along the great dining room tables used in those days.

It was given the name of "coaster," as it could coast around the table.

The invention was pronounced a great success, and was taken up by the gentry of Virginia

all over again. At last the idea was whipped into shape, and then Washington proudly brought out two of his handsomest carriage horses and attached them to the plow. It nearly ruined the horses, for the ground was rocky and the plow began to jump, and the horses started to run away. Later, work horses were substituted and the plow was a success.

Twenty-eight years later Washington, returning to the idea, designed a jaw which would do two things at the same time—sow the grain and plant it. It was a brand-new idea in agricultural machinery. Part of the device was in the shape of a barrel which discharged the grain, while behind was a roller which broke up the clods and kicked earth over the seed.

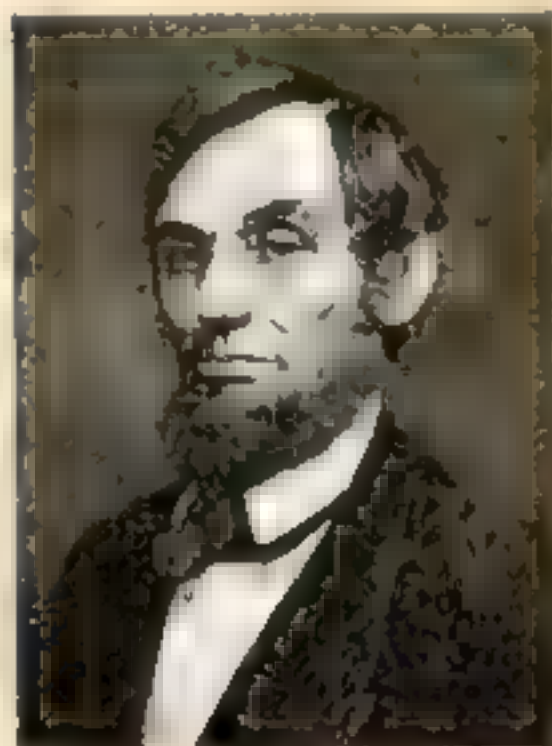
WASHINGTON never tried to make money from his inventions and they were never put on the market. But as President he encouraged inventions, he signed the first patent law passed by Congress and attached his name to the first letters patent issued by the United States.

Lincoln had no interest in stately dinners where a wine coaster would be a useful and pleasing device, or in farming. He was born on a farm and got off it just as quickly as he could.

Lincoln turned to something he knew about. River boating. When Lincoln was twenty-one years old he went on a trip down the Mississippi River to New Orleans on a flatboat and for the work he did he received the salary of twelve dollars a month.

He got as far as New Salem, Illinois, the bottom of the boat grated on a milldam, and stuck. Nothing under high heaven could budge it. The front part

Continued on page 137



During spare hours in his law office, Abraham Lincoln whittled out a model for his device to lift vessels over the shoals.



Mr. and Mrs. Tiger remembered! When their keeper advanced, holding a painting of an African big game hunter, the beasts screamed and fled.

New
Proofs
That

Animals Really Can Think

35118

By ROBERT E. MARTIN

HIS four shaggy feet firmly planted upon an exquisite \$10,000 Persian prayer rug, a Shetland pony stood in the middle of the drawing room at the New York home of Sir Joseph Duveen, internationally known art connoisseur and antiquarian, one evening a few weeks ago.

All but speechless with amazement, a brilliant gathering of ladies and gentlemen in evening dress sat in a semicircle around the little horse. There was the thrilling experience of seeing the fairy tales of their childhood come true.

For here, so close that you could feed him lumps of sugar by stretching out your hand, was a real, flesh-and-blood animal that could "think and talk" in a manner of which Hans Christian Andersen and the Grimm brothers never dreamed in their weirdest fancies!

Why, this marvelous pony could answer any question you asked him! And

ALMOST everyone has wondered at times whether animals really can reason and think. At the recent International Congress for Psychical Research in Paris, the subject, of long scientific conflict, was widely debated.

Here Mr. Martin tells of some amazing examples of seemingly human intelligence on the part of animals. No person, possessed of the slightest curiosity—whether he believes that these resulted from reason or from instinct and training—should miss this absorbing article. *The Editor.*

such questions as they did put to him! And what answers he gave!

The little horse had been placed before two openwork fences on which were hung small tin triangles, each bearing a letter of the alphabet or a numeral from one to nine. By picking off these tabs, the pony quickly spelled out his startling answers to a rapid fire of questions "shot" at him by members of his "audience."

Amazing Stories of
Tigers that Reason,
a Horse that Solves
Deep Problems, and
an Ape that Invents

The animal's replies gave evidence of an almost fantastically human intelligence. He could distinguish between men and women. He told the time. He gave the dates of historical events. He added and subtracted and—solved square-root and cube-root problems!

But judge for yourself whether this pony thinks like a man or not. The "conversation" ran as follows:

"What city is this?"

"New York."

"Do you like to come to town?"

A vigorous affirmative nod of the head was the answer.

"What do you do in the city?"

"Visit."

"Whom do you visit?"

"Nice people."

When the general laughter subsided, the animal was given sums to do. He added and subtracted rows of five figures unhesitatingly and without a mistake!

The clever pony was Black Bear, a

Shetland, whose feats have aroused widespread scientific interest. He was "discovered" by W. W. Fuller, a tobacco magnate, some months ago. At that time the pony, in charge of his owner, a Mr. Barrett, a venerable wanderer who might be called the American counterpart of Trader Horn, came to Mr. Fuller's estate near Briarcliff, N. Y. Both Black Bear and his quaint old master have been guests there ever since.

BUT to return to the demonstration at Sir Joseph's. After Black Bear had shown that he was no mean mathematician, the "interview" was resumed thus:

"Black Bear, were you ever in another body?"

Again the affirmative nod.

"Whose body?"

You could hear a pin drop in the room as the pony reached for the tab. His reply was,

"King Solomon."

A gasp of astonishment from the guests.

"When did King Solomon live?"

"B.C. Long time ago."

"When were you born?"

"February 25, 1917."

The conversation was interrupted once more, this time by Mr. Barrett, who showed the pony a small clock and asked him to tell the gathering what time it was.

Deliberately, Black Bear picked out the figure, "Nine twenty-eight."

"How many minutes to ten?"

"Thirty-two."

"When did Columbus discover America?"

"1492."

At this point, the pony made the only mistake of the evening. Asked to give the date of the Declaration of Independence, his answer was, "July 4, 1775."

"Bless his heart," said one of the women. "Perhaps he's tired."

"Not at all," explained Mr. Barrett; "that was just a slip of the tongue!"

NEXT, Black Bear was told to "go kiss the lady in the pink gown." There were five women in the room. Without a moment's hesitation, the pony walked to the wearer of the dress of the color indicated and "kissed" her.

Now came the final question.

"Black Bear, tell us where you get all your knowledge?"

And the pony spelled out, "G-o-d"! Sir Joseph's friends looked at each other in mute amazement. Then Mr. Barrett casually remarked that the pony could solve square-root and cube-root problems! And so, for another half hour, the marvelous animal found a number of solutions quickly and correctly enough to



An inventor moving the stone. With his trapezius bar, Dohong, the orang-utan, devised a lever with which he broke horizontal bars.

make many a college student jealous.

Black Bear's astonishing performance came as the climax to a series of demonstrations of animal intelligence that have engaged the attention of scientists of late. Fellow, a remarkably bright ex-

year-old German shepherd dog, recently underwent a second psychological test at Columbia University, New York.

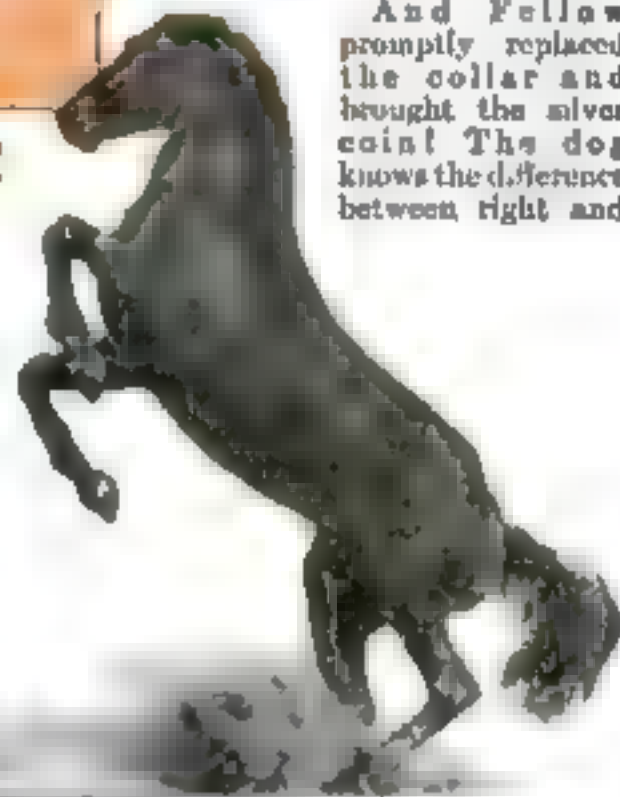
Fellow has a "vocabulary" of about 400 words; that is, he thoroughly understands that number of terms. And he proves his ability by responding to commands, or rather requests, in which that many different words are used. The average person, psychologists say, doesn't use more than about 350 words in his conversation!

SO FINE are Fellow's powers of perception that he can distinguish between the letters of the alphabet, and so knows the difference in meaning between words of closely similar sound. The Columbia psychologists placed a silver dollar and a linen collar beside each other on the floor.

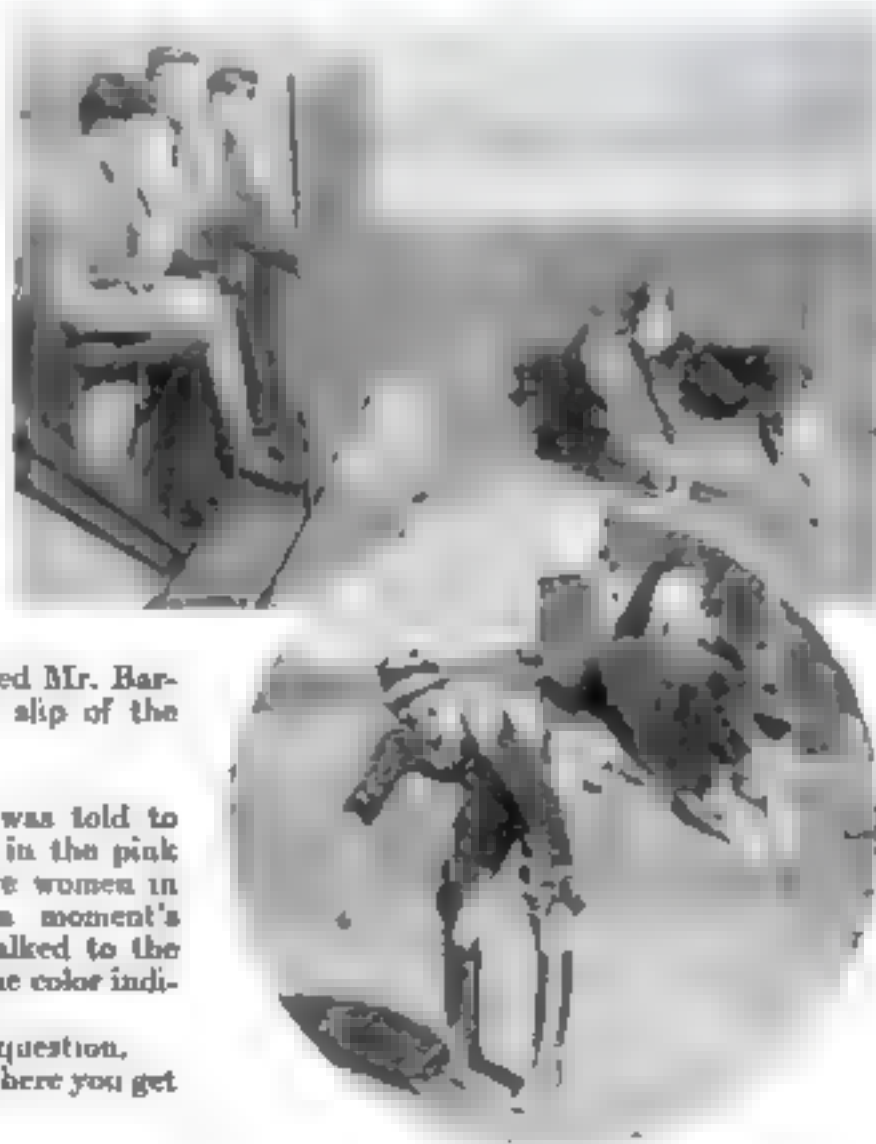
"Fellow," asked Jacob Herbert, of Detroit, his owner, "will you bring us the collar?" The dog leaped forward and retrieved the desired object.

"Fine," said Herbert. "Now put back the collar and give me the dollar."

And Fellow promptly replaced the collar and brought the silver coin! The dog knows the difference between right and



Rex, the wonder horse of the movies, is one of the most temperamental stars of Hollywood. He actually steals his own casts for his pictures. At the left is Fellow, the remarkable German shepherd dog, passing intelligence tests. He knows 400 words. In circle, Rin-Tin-Tin, the famous shepherd dog star of the movies.



left better than some Army rookies, and distinguishes between men and women, adults and children.

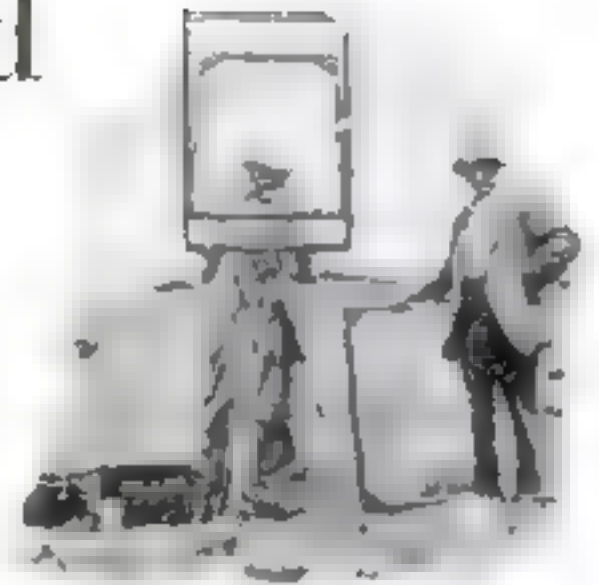
One of Fellow's accomplishments particularly impressed the New York psychologists. Herbert asked one of the men to take the dog firmly by the collar. "Now, Fellow," he said, pointing to the secretary of one of the professors, "I want you to protect that young lady; don't let anybody touch her." The slightest move in her direction brought angry growls. Then, as Herbert himself walked over to the girl and started to touch her, even he was treated to bared fangs and threat-

(Continued on page 146)

Prospecting for Gold With Electricity

Amazing Instruments Find Hidden Ores and Bring New Romances to the West

By GEORGE LEE DOWD, JR.



Two types of direction-finding coils for locating ore deposits. At lower left is an amplifier to increase strength of the signals sent through ground and heard in headphones.

PROSPECTING by electricity is here.

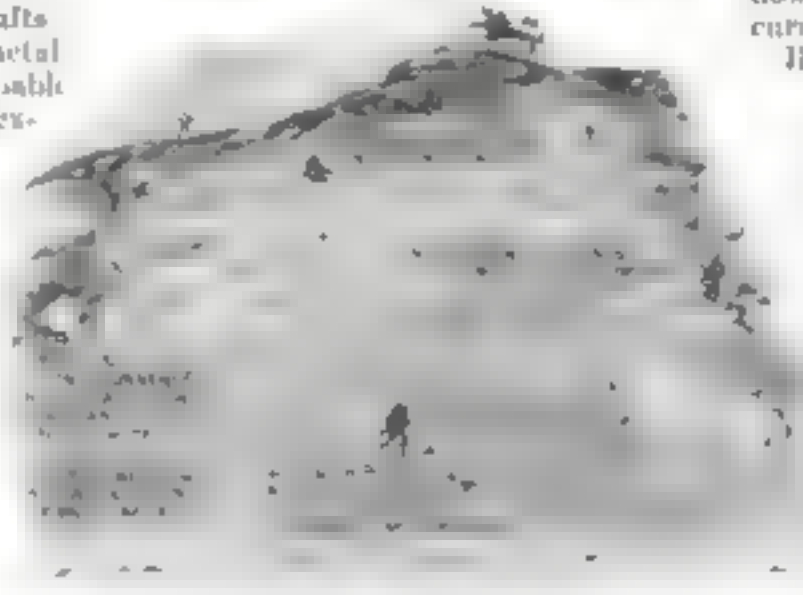
The new method, which the U. S. Bureau of Mines experts have just tried out in Colorado, discovers underground veins of metal without digging an ounce of earth. There is no need to drill costly "test shafts" where someone thinks there is metal. A few electric connections, and valuable deposits of iron and copper ore, the experimenters found, write their location on prospectors' maps. So portable is the apparatus used that it may be carried on the backs of a prospecting party and used to survey great areas for possible mineral stores.

Meanwhile, within the last few months, other fascinating ways of locating underground mineral riches have been developed. Prospecting for oil with earthquake shocks, produced by blasts of dynamite and recorded on seismographs or earthquake-detectors, has passed its experimental stage and is now in use by several great oil companies. Radio instruments are said to detect gold and silver hidden in the earth. Another method, which makes metal ores reveal themselves through magnetism, has been tried out successfully by the Bureau of Mines.

Will participants in the next great gold rush be technical men armed with electric apparatus—figures that look more like telephone men than prospectors?

To picture electrical prospecting in action, imagine the strange scene at Car-

bou Mountain, near Nederland, Colo., where the Bureau of Mines experimenters tried out their apparatus. On a grassy knoll a signaler sits at the key of an Army field telegraph outfit. Two bare copper wires, connected to it, have been laid in



How hidden veins of ore are mapped by telegraph dot and dash signals sent through the ground. The electric current carrying the signals follows the winding course of the underground ore deposits.

parallel lines 500 feet apart along the stubble and rocks of the mountain—and pegged to the earth, every hundred feet, with metal stakes for electric contacts. As the telegrapher presses a key, a pre-arranged signal—three dots and a dash—flashes along the wires and into the earth.

With headphones on his ears and a rubber boot on one leg, a man is seen strolling about seemingly aimlessly, a few hundred feet away.

He carries a trailing wire tethered at one end with a ground stake. Wound about the rubber boot is a bare wire of copper that he grinds into the earth at each step.

Actually he is listening intently to a three-dot-and-dash signal he is receiving in the headphones from the earth. Sometimes it grows louder as he walks, now fainter. It has stopped altogether. He halts, and marks the spot upon the ground. That is a "silence point" that will be used to map the precious ore.

By these "silence spots" he can tell exactly what path electric currents take as they course through the

earth from one of the parallel, pegged-down wires to the other. And the electric currents follow the ore!

Hidden ore deposits are better conductors of electricity than the rock and earth that surround them. In that fact lies the whole secret of electrical prospecting. As expected by Dr. A. S. Eve and Dr. D. A.

Keyes, who headed the exploring party, charts plotted from the headphone man's findings showed that the underground electric currents traveled in crooked, curving paths from one wire to the other. From these charts they mapped the probable location of an ore body that would play such tricks upon an electric current.

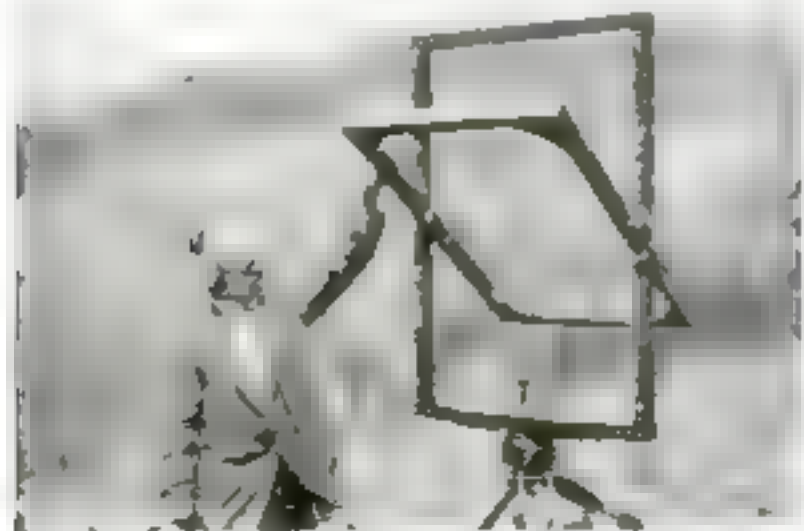
THEN they compared the mythical ore body on their map with an actual deposit of magnetite, a rich iron ore,

which a laboriously executed map of the U. S. Geologic Survey showed to exist in that locality. The two maps agreed exactly upon its location. In a few hours' time the Bureau of Mines experts, without even scratching the surface of the soil, had charted a vein of iron ore that the U. S. Geologic Survey had taken months to map.

The same electrical apparatus will detect gold, silver, copper, or practically any metallic ore that is a good conductor of electricity. Copper was located in another electrical test at Ward, Colo., a few miles from the scene of the other experiments. Also, the prospectors found that certain sulphide ores of copper and iron—and there are other sulphide ores of more precious metals—are themselves natural storage batteries, generating faint underground currents that lead to their detection.

THE experimenters tried a half-dozen varied "hook-up" methods before they left Colorado. A "Pittsburgh coil" and a "leapfrog method" of electric ore-detecting were two novel developments.

The Pittsburgh coil, a sort of square looped aerial of their own invention, replaced the man with the headphones. It was not connected to the earth, but was swung about like *(Continued on page 133)*



The "Pittsburgh Coil" devised by Bureau of Mines experts to prospect for buried ore. Like a radio direction finder, it can be turned and tilted in any direction. When no hum is heard in the headphones, direction of coil indicates position of ore.

Liquefied Helium Boils on Ice and "Freezes" Tin

By ARTHUR A. STUART

Only America has enough helium to inflate its airships with the nonflammable gas.

A FEW weeks ago the little Navy blimp J-3, descending to its hangar at the Lakehurst, N. J., air station, ran afoul a weather vane. With a ripping noise her gas coils parted, and 22,000 cubic feet of helium gas disappeared to wander about among the elements, perhaps for ages before being captured and put to work again.

Only ten years ago that little mishap would have cost the Navy approximately thirty-six million dollars. In fact, helium then, little known outside the laboratory, was so rare as to be virtually priceless. All lighter-than-air craft—German, British, French, Italian, and American—were filled with the highly inflammable hydrogen gas. Yet today the loose change in your pocket might buy a barrel of helium, a cubic foot costing only about three cents.

For within the last few years new fields of natural gas, from which come high percentages of helium, have been discovered and new and cheaper methods of extracting it have been developed. It is said, for example, that the new plant near Amarillo, Texas, in which the Government is at the present time installing machinery, can supply the entire needs of the United States for many years to come.

AND the United States is the only nation having, so far as anyone knows, any considerable quantity of helium. It is an all-American product. Practically the world's entire supply—which is to say, the United States', for its export is forbidden by law, as an American firm found out when a Canadian University and a Czechoslovakian scientist wanted supplies—comes from the

natural gases of Texas, Oklahoma, and Kansas.

Helium, named from the Greek word "helios," meaning "the sun," is a colorless, odorless, tasteless ~~nonflammable~~ gas with about 92.3 per cent of the lifting capacity of hydrogen, the lightest gas known. It was first discovered in the sun by means of the spectroscope, in 1868, and discovered on the earth, in supposedly infinitesimal quantities, in 1893.

Because of its lightness and non-inflammability, its chief use has been to

fill the gasbags of balloons and airships. A dirigible filled with it cannot be shot down in flames, nor is there danger of a disastrous explosion set off by motor exhaust, ignition sparks, or a carelessly lighted match, as is the case with a hydrogen-filled airship. Some appalling examples of this danger are very well known.

WHEN the giant dirigible *Graf Zeppelin* made its recent flight from Germany to the United States, smoking was forbidden. No food was cooked.

Precautions were taken even against the flashing of a tiny spark from a tack in the heel of a passenger's shoe by contact with metal in the ship's deck. At the Lakehurst, N. J., landing field every spectator was handed a printed request not to smoke, even in the open air. The huge silk, rubber, and metal sausage was filled with hydrogen, probably the most highly inflammable substance known. A chance spark might have caused a great catastrophe. Meanwhile the *Los Angeles*, pride of the Navy, nestled safely in its

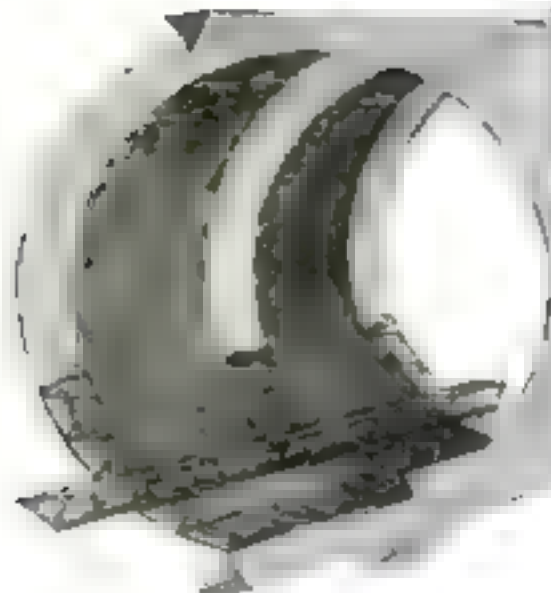


Part of Uncle Sam's helium laboratory in Texas, where experiments have developed new and cheaper methods of extracting this valuable gas.

HERE is told the story of the strangest gas in the world. First found in the sun and used mostly to inflate airships, it is now proving valuable in radio, deep-sea diving, lighting systems, metallurgy, medicine, and for toilet preparations. Its price, once prohibitive, has been reduced to almost nothing. Mr. Stuart tells how, in a few years, scientific experiment and discovery have brought an almost priceless rarity into everyday uses for mankind.

Below: Hundreds of small cylinders of helium waiting shipment. It took 12,000 of these to fill the *Schenandoah* at her first inflation.





hanger—its gasbag filled with fireproof helium.

BESIDES the inflation of airships, within the last year or two, other uses for helium have come to light. Helium, it has been found, will prevent the "bends" or caisson disease that affects deep-sea divers. It is used in metallurgy, fills radio tubes and glow lamps, and finds a place in nautical and other scientific instruments. It cools electric transformers and high-speed generators. It is an important aid in chemical drying plants, and assists in the manufacture of cold cream and shaving soap.

Helium is the least soluble of all gases in water or other liquids—a marked contrast, for instance, to the carbon-dioxide "fizz" of charged water. It is this property that makes it a boon to deep-sea divers. The excessively painful cramps or "bends" felt by a diver emerging too suddenly are believed due to bubbles of nitrogen gas, normally a part of the air, which are forced into his blood under high pressure and cause acute distress when they froth out as he reaches the surface. Since helium will not dissolve in the blood, an oxygen-helium mixture is supplied to the diver instead of air, and experiments indicate that the menace of the "bends" is ended.

Helium is insoluble, too, in molten metals, a fact that makes it a valued tool of metallurgy. Helium, although lighter than air, is stickier. This peculiarity makes it ideal for filling the interior of nautical and other scientific instruments. In these, delicately balanced parts seem to swing interminably before they slow sufficiently for readings to be taken. An atmosphere of helium instead of air "dampens" the vibrations and makes reading easy.

RADIO tubes and glow tubes such as are used in television are filled with helium gas, in the first instance because of its usefulness in permitting electrical current to pass in one direction only, and in the second, because of the brilliant glow produced by an electrified tube filled with low pressure helium. This glow is not unlike that of neon, whose scarlet light is familiar in advertising



Design for the two huge dirigibles largest in the world to be built for the U. S. Navy. Each will have more than twice the helium gas capacity of the *Los Angeles*. In the drawing the envelope is broken away revealing complete hangar or airplane room capable of housing five or six big planes. All engines will be housed in the hull eliminating the external cars. At the left is a cross-section view of the hull showing internal structure and the interior.

signs, but where neon gas gives a red light, that of helium is a soft yellowish-white.

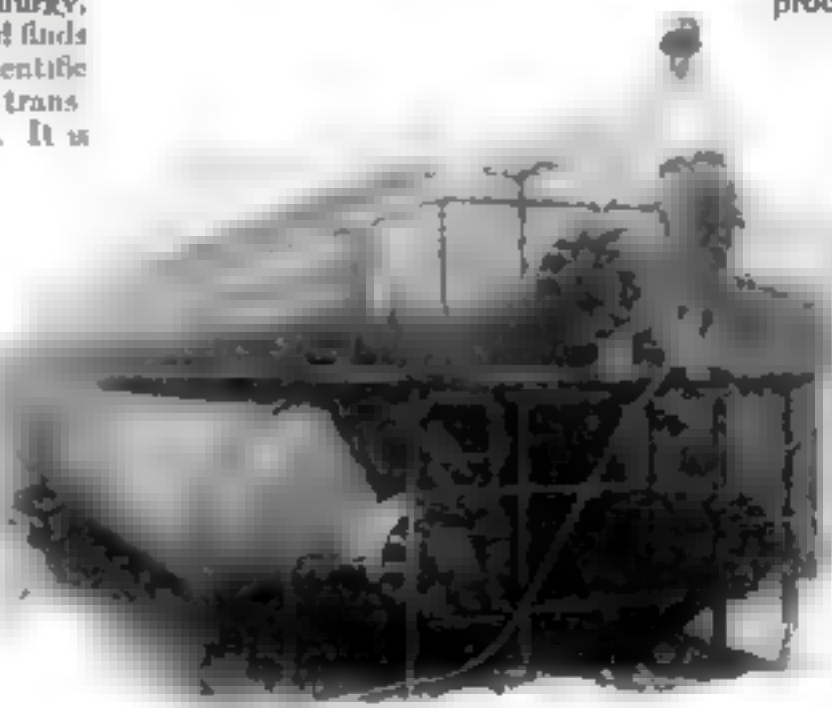
Helium conducts heat six times as well as air, you would shiver if you were surrounded by helium, for the gas, permeating your clothes, would draw off your body's warmth in no time. Moreover, it has a high specific heat, which means

with air excluded, through the presence of helium.

The gas has other queer characteristics, which some day may be put to work. Chilled until it changes from a gas to a liquid, for instance, helium is the coldest known fluid. It liquefies at about 450 degrees F. below zero, and has been chilled by Prof. Kamerlingh Onnes, at Leiden, Holland, to the coldest temperature ever produced by man—457 degrees below

zero, or within two degrees of that "absolute zero" that physicists call the rock bottom of the temperature scale.

Some of this super-chilled helium, dropped in the middle of the south polar ice sheet for which Commander Byrd and his exploring party are heading, would boil like water on a red-hot stove. At its temperature a tin cup becomes brittle as glass, and mercury freezes so solidly that you could make it into a hammer head that would drive a nail. Only by immersing other substances in liquid helium can they be made as cold, no other substance has its chilling power.



Newly designed helium tank car, consisting of three tanks forty feet long and five feet in diameter, containing helium under pressure. Twelve of these carloads will fill the *Los Angeles*.

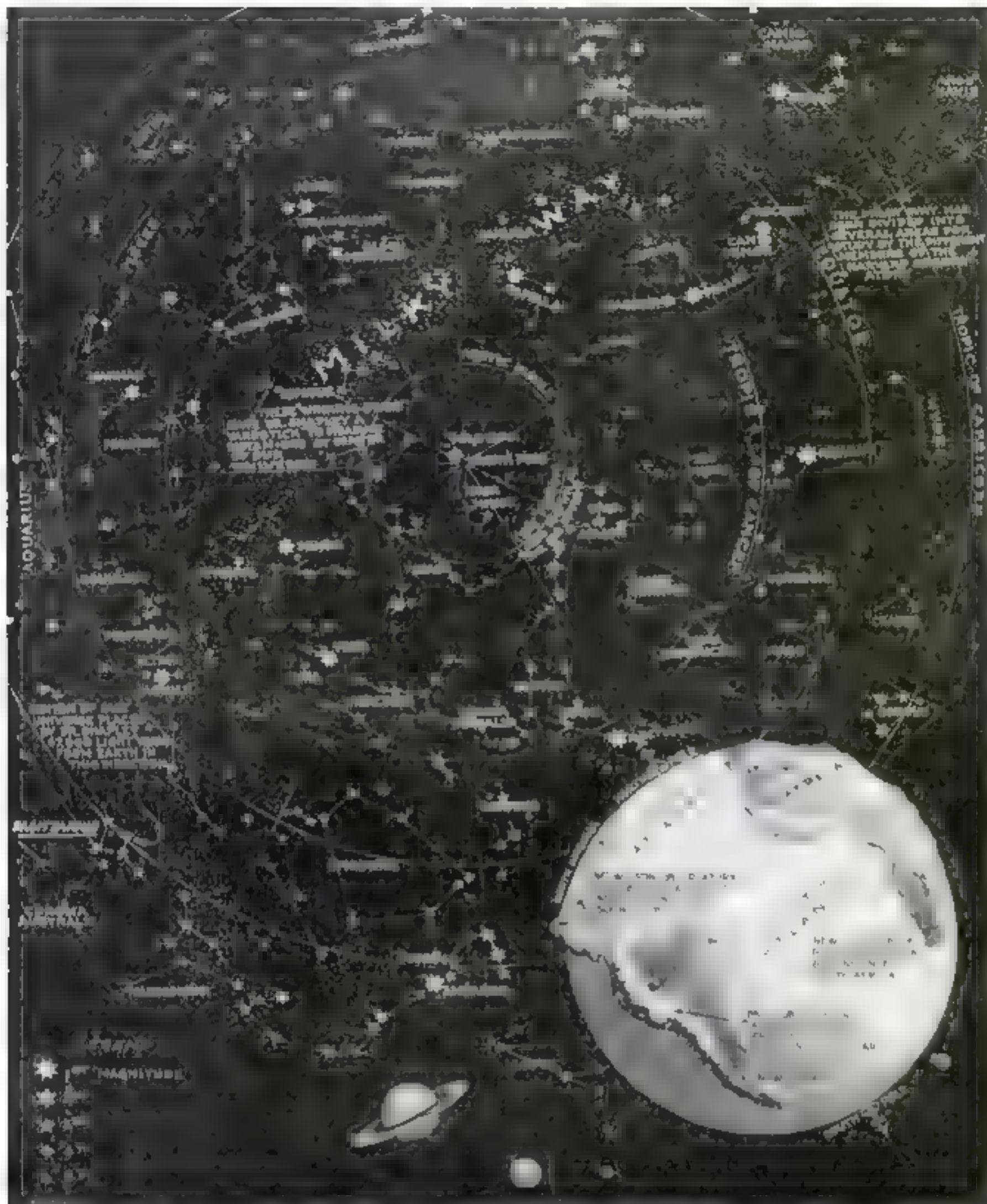
that it can absorb much warmth without itself rising appreciably in temperature. These facts, coupled with the advantage that it is a poor conductor of electricity and therefore proof against short circuits, make it an excellent cooling blanket for high-speed dynamos, and a safe substitute for oil as a contact breaker in transformers.

DRYING operations are sped by the use of helium. Although it is not yet practicable to hang up your wash to dry in a tank of helium gas, the clothes would come out moisture-free in double-quick time. The reason is that water and other solvents evaporate much more speedily in helium than in air. Practically this is important in chemical factories, where trays of chemicals are efficiently dried under air-free hoods containing helium.

In the manufacture of toilet preparations, such as shaving soaps and cold cream, helium recently has proved valuable because of its insolubility, already mentioned. Soaps and pastes are mixed

one of them. Prof. Karl T. Compton, of Princeton University, has reported that it will combine with mercury in a vacuum tube, when the mercury has been rendered active by invisible ultra-violet light.

Perhaps these properties will suggest new uses in time. One thing is certain—that none of them will equal in novelty some of the entertaining suggestions that have been received by the trade research department of a commercial helium company of Dexter, Kansas. A St. Louis inventive genius had an idea for a crashless airplane. If the motor failed, a tank of highly compressed helium on the under side of the fuselage was to support it in the air—only it wouldn't. Next came a man with a talent for advertising. He proposed to make and sell gaudy painted windmills, whose whirling blades were to attract attention to the advertising placard they bore. The only trouble was that the wheel bearings had a way of wearing out. Wouldn't a little tank of helium—about the size and shape of a quart mason jar, he suggested—suspend the windmill. (Continued on page 139)



A New Guide to the Heavens

IMAGINE a giant disk wheel whirling in space. That is our universe as astronomers now picture it. Dr. Harlow Shapley, director of the Harvard College Observatory, Cambridge, Mass., has just announced that, 47,000 light years distant in the direction of the constellation Sagittarius, he has discovered the central hub about which it spins.

This hub he estimates to be 29,000 light years across and 10,000 light years

thick. A light year, the distance a beam of light will travel in a year, is about six trillion miles. For his measurements, Dr. Shapley used as a yardstick the Cepheus variable stars—"winking stars" whose changes in brightness permit complicated astronomical calculations of their distance from the earth.

Dr. Shapley also reports the discovery of 8,000 spiral nebulae, each believed to be a universe like ours, revealed by photo-

graphs made at the Harvard Observatory in Peru. The total number of these "island universes" is estimated by Dr. Edwin Hubble, of Mt. Wilson Observatory in California, at ten million, somewhere in space, astronomers believe, is a center of centers about which they spin.

Above our artist has charted the important stars and groups of stars in our universe. You'll find the drawing unusually helpful in identifying the stars.

S O S!—A Challenge to Science



A lifeboat is lowered from the side of the ship. The boat is suspended by ropes and is tilted at an angle, with its bow pointing towards the water. The ship's hull is visible in the background, showing the structure where the lifeboat is being launched.

HELPLESS women and children in battered lifeboats, dangling at the steel side of a sinking ship, doomed to be swallowed in the sea! Who, after the investigations that followed the tragedy, has not been stirred by the verdict of marine experts that "it could have been prevented!" Here is told how inventors are answering the *Vestris* challenge.

By FREDERICK TISDALE



Our artist here pictures the difficulty of launching lifeboats from the high side of a heavily listing vessel. The descending boat must scrape against steel plates of the steamer's hull, causing breakage or upsetting, with loss of life.

AFTER every great sea disaster humanity searches for devices and regulations that will prevent the recurrence of such horrors. The Lamport & Holt liner *Vestris* sank two months ago off the Virginia Capes with a loss of 111 lives. She lies on the floor of the Gulf Stream two miles below the surface white caps.

As a result of searching investigation into this disaster it becomes apparent that if similar tragedies are to be prevented in the future, it will be because of the progress of science and the achievement of invention. Old outmoded life saving equipment must be discarded or improved; new contrivances created and perfected.

A new type of lifeboat, recently exhibited and tested in London, for example, might have saved some of those lost in the *Vestris* tragedy. This craft, reversible, self-emptying and unsinkable, is somewhat similar in appearance to the ordinary lifeboat. But a cross-section resembles a shallow letter "H" and the upper and lower portions are identical in construction. Thus, the boat is still a boat when it upsets! In addition, it is made self-emptying by a system of non-return valves that operate no matter what side happens to be uppermost. Sealed airtanks give it buoyancy and keep the deck-level always above the water line.

In tests at the London docks, one of

the boats, capable of holding sixty people, was loaded with 180 sandbags to represent their weight. First, the non-return valves were stopped up and three tons of water pumped into the boat. The gunwale remained well above water level. Then the valves were released and the vessel emptied itself in a little over one minute! To simulate lurching in a stormy sea, the sandbags were transferred, one by one, across the boat until one side was light and the other fully loaded. Still, the gunwale remained above water. An ordinary lifeboat, put to the same test, began to sink after the seventh sandbag had been carried across!

EVEN such boats, however, would not solve entirely the problem of safety at sea. One of the greatest difficulties lies in the launching of lifeboats in the hour of peril. The trouble is that many seamen no longer are sailors.

In the good old days of the clipper ships—of "wooden ships and iron men"—crews consisted of fellows who were past masters in handling ropes, cars and tackle. But modern steamers are really intricate collections of marvelous machinery, and the men who work them, many of them sea-going hotel men, have no need, under ordinary conditions, of

skill in seamanship. And difficulties in the lowering of lifeboats today are intensified by the fact that the deck of a passenger vessel may be sixty feet above the water—the height of a six-story building!

THE fact that few women and no children were rescued from the *Vestris* testifies to the failure of life saving equipment. Pictures, raw and vivid, leap out of the tales told by survivors, emphasizing the defeat of mechanics and sailors by the deadly force of the ocean.

A fireman, Boxill, testified that he took his station in a lifeboat filled with passengers. The boat was lowered part of the way—and stuck. He and another member of the crew stood with drawn knives waiting for the order to cut the gear and release the boats. The *Vestris* rolled over while the boat swung in mid-air, spilling the passengers into the water. Boxill swam to a piece of wreckage.

"There were some dead children and women around there, sir, and that got me kind of dizzy. I . . . swam off."

Charles W. Johnston, a passenger, saw two boats hanging to the ship, loaded with women and children, when she

went down. A member of the crew said that a boat stuck on the side of the *Vestris* instead of sliding into the water. Two members of the crew cut away the ropes with knives, but the line at one end parted first "and emptied everybody into the water." Another struck something and was launched with a hole in her side.

THE sad inventory of these boats illustrates one great difficulty encountered in a sinking ship. Rarely do stricken vessels go down on an even keel. They list or lean either to one side or the other. This lifts the high edge of the boat deck away from the water and places the side of the ship below the lifeboat. When the lifeboat is lowered it must scrape the parent vessel's hull as it descends and this hull is a series of irregularities where the steel sheets overlap, and where rows of rivet heads protrude. On the other hand, the list places the opposite side of the deck nearer the water and makes it easier to lower the boats there since the drop is unobstructed.

The *Vestris* had a starboard list. In landlubber English, that means she leaned to the right. This brought the starboard boats close to the water and lifted the port or left side boats high in the air, placing the ship's hull below them. It was in the lowering of the port boats that the disaster struck most heavily.

But science and invention have begun to solve the problem of lowering boats quickly in emergency. The latest and finest devices for handling lifeboats are to be found on the new steamships of at least one line operating from New York. Small electric winches lower and raise the boats. An equalization device keeps the small craft on an even keel as they drop toward sea-level.

ONE of the loudest public outcries usually heard following shipwrecks is to the effect that the wooden lifeboats leaked. And in that connection the owners are accused of culpable thrift.

Such complaints are due to a popular fallacy. As a matter of fact, a wooden boat is more expensive than one of steel.

In addition, certain countries, Great Britain among them, require the use of wooden boats. Why? Because experts agree that they are better. The best materials are spruce and pine. The finest type is clinker built, that is, from planks that overlap each other. The objection to metal boats is that they are not as strong. Any smashing or denting

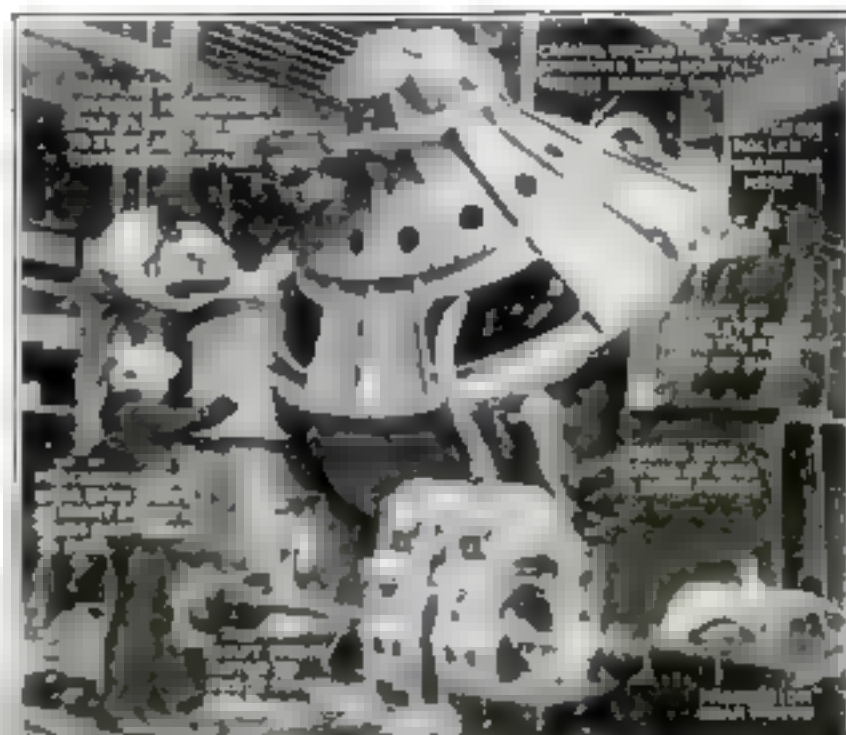


Latest device for launching lifeboats. Mexicanos are swung well out over the side and kept the boat on even keel as it is lowered by powerful electric winches.

upsets their equilibrium and when punctured they are hard to repair.

Rafts are another form of safety equipment upon which inventors are concentrating. Many important passenger ships today carry one or more liferafts made of balsa, the lightest of all woods. The balsa tree, which grows in the mountains of Bolivia around the shores of Lake Titicaca, is lighter than cork. Radio fans have become familiar with its wood, which has been used in making loud speakers. One or two liferafts of balsa wood might have helped save some of the women and children of the *Vestris*.

The best type of liferaft, marine authorities agree, is the catamaran. It is kept afloat by two long pointed air-filled metal cylinders. Between these is a wooden platform for the passengers. The finest have copper cylinders, to prevent rusting, and they are divided into compartments so that, if one section is damaged, enough air remains in the others to keep the craft afloat. There are rowlocks for



Science's answer to the problem of preventing serious lists such as proved the *Vestris*' undoing. The whirling flywheel of this stabilizing gyroscope will bring a ship back on an even keel, even if the cargo shifts.

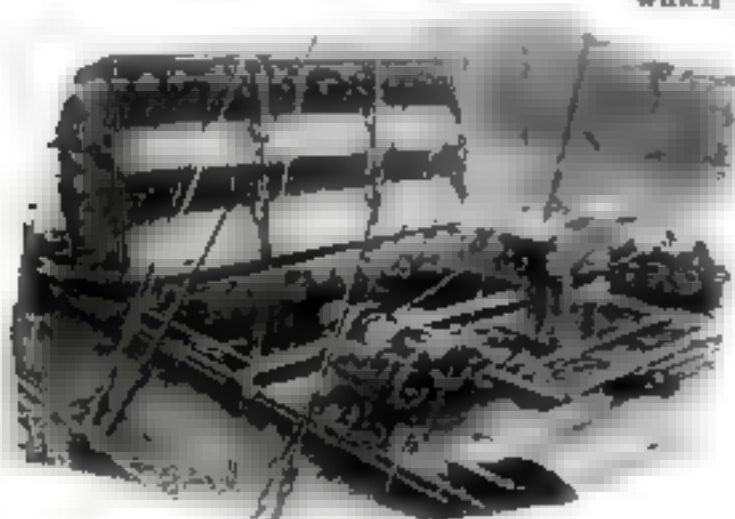
propulsion and steering. The tops and bottoms are alike, as in the case of the lifeboat, described above, so that it makes no difference how the raft strikes the water.

Science, too, already has answered the question: How is it possible to prevent lists such as proved the *Vestris*' undoing? Someday I believe, every ship carrying passengers will be equipped with stabilizing devices which will keep her on an even keel and bring her back even if her cargo shifts. Already many yachts and a few naval craft are so equipped. The gyroscope stabilizer is the device that does the trick. A gyroscope is a flywheel mounted so that it is

free to revolve in any direction. Make it big enough, heavy enough in the rim and it will resist every effort to tip it out of its original plane of rotation. Some large yachts that have stabilizers ride with decks as level as a ballroom floor through storms which would set the greatest liners rolling. One Japanese cruiser was brought from a thirty-degree roll to an even keel in a few seconds by means of the gyroscope.

LIFE-BELTS of a type far superior to the standard "vest" type many passenger boats are still carrying, and which were carried by the *Vestris*, now are available. This type of belt makes it almost impossible for the wearer's head to be submerged. One may go to sleep in the water without danger of drowning, while with the ordinary life-belt constant effort and wakefulness are necessary.

Meantime marine engineers and architects of all seafaring nations consider the perfecting of the unsinkable vessel their greatest and most pressing problem. When this goal is reached and inclusion of the latest safety-devices in ships' equipment is compulsory, science and invention will have accomplished their purpose of relegating ocean disasters to the past.



A new safety substitute for the usual heavy, awkward wooden hatch cover. This hinged cover of light, strong metal, can be closed quickly and easily if a storm rises.

If You Had Millions to Spend—



Two flying laboratories of the Guggenheim Fund, piloted by veterans, carry on experiments to conquer fog on airways.

A FEW weeks ago a new research laboratory was added to the world's gallery of modern scientific developments.

It is a laboratory without test tubes, retorts, microscopes, and Bunsen burners, and without learned looking men using these intriguing paraphernalia for purposes of minute investigation.

This new "research bureau" hurtles through space. It consists of two airplanes. The "professors" in charge are experienced aviators. And its aim is the ultimate defeat of the flyer's most dangerous enemy—fog!

Equipped with a wealth of instruments, the unique flying laboratory conducts its experiments on a section of an established airway in the East. Here a thorough study of fog flying is made under regular operating conditions.

Hope runs high that, as a result of this practical pioneering work, the airman's worst foe will be beaten to a standstill at last.

The flying laboratory was conceived and established by the Daniel Guggenheim Fund for the Promotion of Aeronautics. It is the latest in a series of valuable contributions toward the progress of aviation made by the organization which is probably doing more than any other agency to hasten the day when all the world will be on wings.

THE Fund has set itself the task of making aviation safe for humanity and humanity receptive to the benefits of aviation. This program it carries out in a thoroughly practical way. It has endowed special schools of aeronautics in some of our leading colleges and universities. It planned and financed Lindbergh's celebrated nation-wide tour. It conducts experiment and research activities. It

WHAT would you do? Harry Guggenheim chose to go in for aviation. He marshalled the forces of science to conquer the flyer's deadliest foes, and to make airplanes as safe and useful as automobiles. Here is the story of a twentieth-century pioneer, a man who looked into the future. It forms a stirring episode in the drama of the air.

By MICHEL MOK

organizes international movements designed to promote the safety of flying. Just now it is engaged in a nation-wide campaign to have the towns and cities of the country identified by roof-marking for the guidance of the airman. In brief, all of its activities are directed toward the perfection of aircraft and toward the development of that attitude of public confidence toward aviation which has come to be known as "airmindedness."

Somebody once aptly said that every institution is but the lengthened shadow of a man. Eager to measure the stature of the personality behind an organization that is preparing a way through the clouds for you and me, I sought the headquarters of the Guggenheim Fund.

There, in an unostentatious office, unencumbered by fancy-titled assistants, expensive furniture, or red tape, I found Harry F. Guggenheim, president of the Fund.

Names often have a way of subtly suiting their bearers. The friendly informality of this man's first name fits him like a glove. About forty, blue-eyed, tanned of skin, well set up and proportioned, and the possessor of a ready, engaging smile, he is the kind of chap who is likable at first sight because he combines inherent dignity with a deep-seated, genuine interest in his fellows that is betrayed in almost every word and gesture.

At once I understood how he must have appealed to Lindbergh, his sworn friend, from the moment Guggenheim, then a total stranger, shook his hand and wished him "Safe landing!" the day before he set out on his epic trans-Atlantic flight.

In the course of our chat, I caught the color and outline of a strong, rich personality, one that shapes dreams into deeds, that bridges the gap between the philosopher and the organizer, the scientist and financier.

"The first word in aviation has hardly been spoken," he told me, "but you and I will see the day when the average man, and woman, too, will fly with the same

comfort and safety they enjoy driving around in their automobiles today."

There are many who share that vision, and many more who still scoff at its mere mention. But this man gives without stint of his time and his talents to bring about a quick realization of the old dream of breaking the ties that bind humanity to earth.

I SOON found out why. To Harry Guggenheim, airplanes are the harbingers of peace, the instrumentality that eventually will bring about a true and lasting sympathy among the nations. This underlying sentimental reason for his absorbing interest in aviation be revealed when I asked him what he considered the greatest single contribution the airplane had made to modern progress.

"Its annihilation of space," was his quick reply, "and through that, its establishment of closer communion between various communities. At one time, not so long ago, the populations of our East and West were practically two different peoples because of the distance that separated them. They had their own customs,

traditions, viewpoints, and aspirations. The railroad came and did much to improve that situation. The airplane is doing and will do the rest! The next step will be the binding together of nations, with the thorough understanding of each other's ideals, needs, and problems that is bound to follow."

Curiously enough, Harry Guggenheim originally saw the potentialities of the airplane as a powerful ally of peace and progress when a

pilot during the World War.

As a boy, he had spent one term at the Sheffield Scientific School at Yale and had worked in the mines and smelting plants of Mexico for the American Smelting and Refining Company, one of the concerns controlled by his father's firm. Later he got the degrees of Bachelor and Master of Arts at Cambridge University in England. There he (Continued on page 168)



Daring pilots are trying to solve the problem of overcoming perils of sleet storms which cover airplane wings with icy weight.



H. Rose - 1964

Harry F. Guggenheim, Godfather of Flight

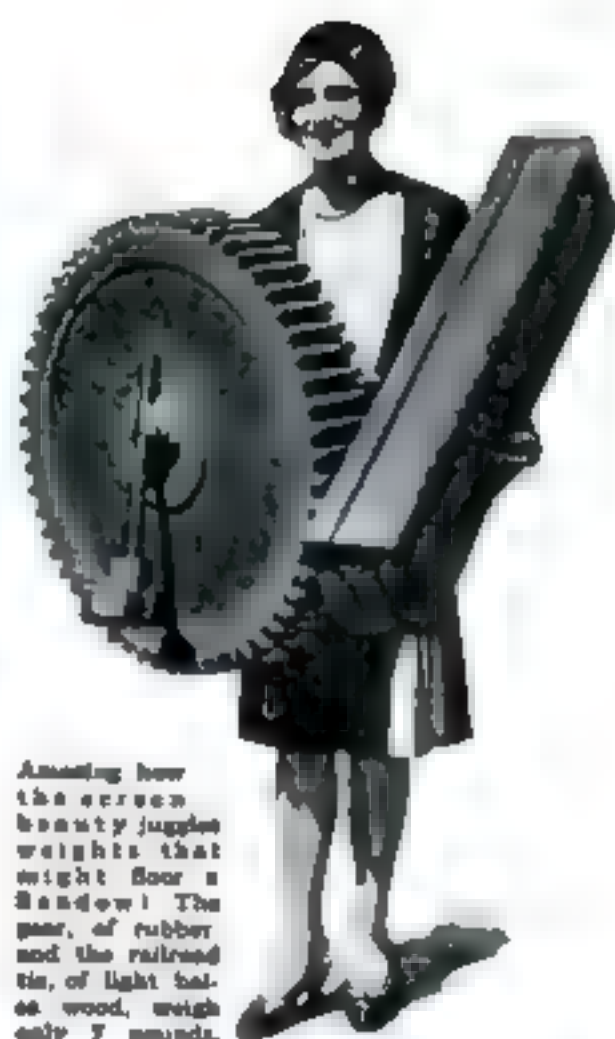
As President of the Daniel Guggenheim Fund for the Promotion of Aeronautics, he has taken the lead in making air travel safe for everyone. "The first word in aviation," he says, "has hardly been spoken."



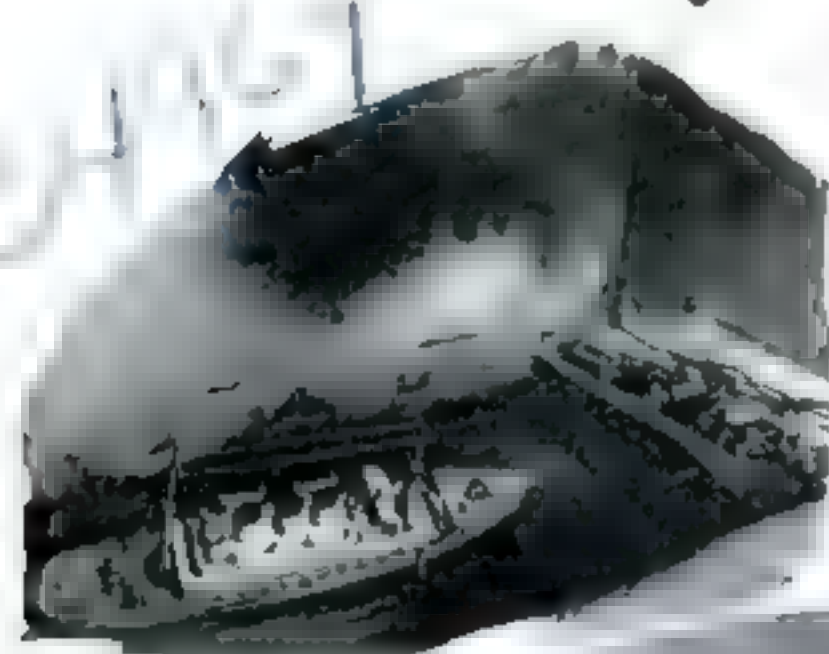


You hold your breath to see the hero, in his high-powered roadster, racing a motor cop. The scene is filmed with tiny model cars, standing still. A moving back drop gives the effect of high speed.

Making Movie Thrills with Tiny Toys



Amazing how the screen beauty juggles weights that might floor a bandow! The gear, of rubber and the railroad tie, of light balsa wood, weigh only 7 pounds.



On the screen it looks like a sure-enough ocean liner, tossed by a real hurricane in mid-Atlantic. But in the studio where the picture was made the liner was a model ship bobbing in a tank no larger than a bathtub. It was rocked and tossed about by a wave-making mechanism operated by a small electric motor.



A remarkably faithful model of the city of Detroit used in a movie thriller. The figure of the hero, superimposed, appears to do breath-taking stunts atop a tall building.



Remember how Douglas Fairbanks rode the magic carpet through the air in *The Thief of Bagdad*? Well, it wasn't Doug at all. The riders were puppets, and the toy carpet was manipulated by wires.



Left: Skilled toy makers of the movies constructed a street of model stores and office buildings smaller than doll houses. Photographed at close range, they appear as real, full-sized buildings on the screen. By trick photography the human figures and action of the drama are superimposed on this setting.



This miniature ship captain's cabin, rocked by motors, serves as the setting for an exciting mutiny in a storm. Depicted on the screen, the curching room seems real enough, with action superimposed.



It's a long way down, and no elevator. Here Mrs. Williamson is entering the flexible steel tube that leads to the camera "studio" on the sea floor.



Taking notes on the drama of the deep. Just beyond the heavy glass window is a frolicking school of curious "sergeant-major" fish, so-called because of their stripes of black and gold.



Dry and safe in the camera chamber, Mrs. Williamson watches a native diver outside the window pluck a sea-fan of incalculable beauty.

Now the deep-sea chamber works. Observers descend by ladder through a steel tube, hung from the ship.



Ringside Seats on the Ocean Bottom

A VICIOUS shark prowls along the sea bottom hunting for prey. Stealthily on his trail glides a monster sucker fish, bent on attaching himself like a parasite to the undersea destroyer. This and other thrilling dramas of the deep are revealed in remarkable photographs snapped recently at the sea bottom off the Bahamas by J. E. Williamson, pioneer undersea photographer, and Mrs. Williamson.

Their camera studio at the ocean's cellar is a globe-shaped steel chamber fitted with a window of massive glass. It hangs from a cruising ship by a flexible, hollow shaft of steel that stretches like an accordion to form a variable "hole in the sea."

This weird contrivance was invented years ago by Charles Williamson, father of the photographer for deep-sea salvage. The younger Williamson and his bride have adapted it as a movie studio, and as a chamber from which divers emerge to gather specimens of coral.



A prowling beast in the deep. This remarkable photograph of a shark hunting its prey along a coral reef was snapped by Williamson from the diving chamber.



The photographer and his wife in the cozy chamber. At the left is a water-tight door through which divers can pass. Note headphones.

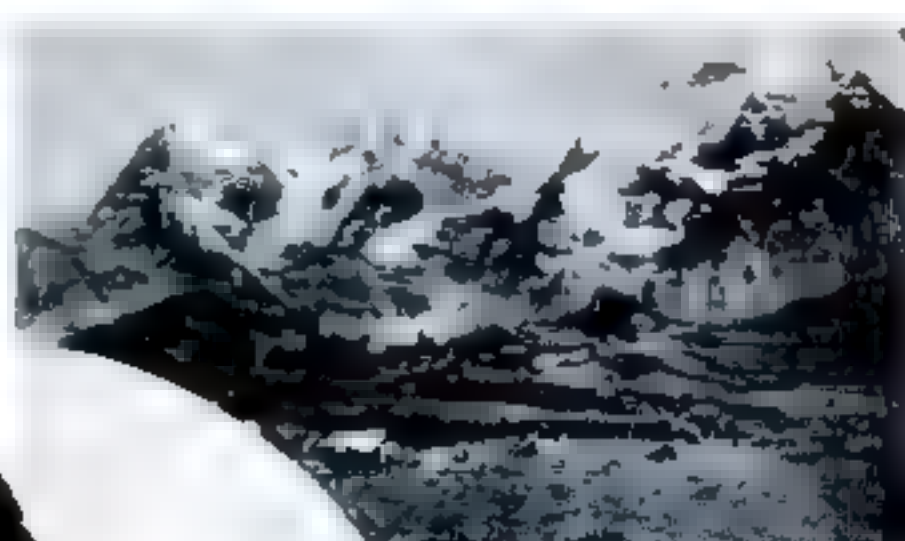
Right: Action photo of an unusually large sucker fish that lives by attaching itself to a shark and watching food away from its host.



One Jump Ahead of Death!



A thrilling sport for the sure-footed. Crossing a narrow ice ridge atop Mt. Robson in the Canadian Rockies.



A great playground for mountain climbers—the challenging peaks of Eiger and Jungfrau in Swiss Alps.



Will he make it? This climber risks a flying leap across a 12-foot gap on the Matterhorn.



Almost straight up! Roped together, Alpine climbers scale sheer walls of rock, struggling for toe-hold on the mountain's ragged face.



Would you like to be in his shoes? It takes a real athlete to cross a treacherous "chimney" in the wild Swiss peaks of the Alps.



Somewhere, high on the Matterhorn, a mountain climber is lost. A searching party sets out in the night, carrying flaming torches to light their difficult way over the treacherous ice.

In the game of tag with death, every mountain climber finds his reward in the thrill of reaching his goal at the tip-top after a perilous ascent. The view above shows a conqueror of one of the towering pinnacles in the Swiss Alps, roped to a comrade just below.



Where can misstep may mean a plunge of hundreds of feet into the depths of a yawning crevice. Here two climbers stand at the brink, deciding whether to try the crossing.

Strange Sights Snapped By Our Camera Men



Left: Interior of one of the up-to-date cave homes of Yeng, showing comfortable furnishings and clean rock walls. Even here electricity serves the housewife.

Modern Cave City

Cave dwellers, whose homes in the cliffs are equipped with electricity and other modern conveniences, form one of the strangest villages in the world, called Yeng, on the banks of the Loire River, southern France. At the right is the main street of the village, a stairway up the face of the cliff. It leads past the entrances to homes carved from rock wall.



This Dentist Had Courage

Olga the leopard, had a rumbling toothache and kept the other inmates of a Los Angeles zoo awake at night. So her trainer, a young woman, took the beast to a courageous dentist, placed her in the chair and held the ferocious jaws apart while the cavity was filled. Olga jumped only once, and never growled.



Light Organ Paints Scenery

Colorful symphonies played with light instead of sound and canvases painted without pigment are suggested by the invention of a new light organ called "Clavilux." One of its possibilities is the substitution of beautiful, changing color forms for costly stage settings. Above is a dancer performing before a backdrop of light projected from the instrument. At the right the inventor, Thomas Wilfred, is seen at the console of the new organ.



Drives Rocket Motorcycle

Speeding at thirty miles an hour over a board track, a rocket-propelled motorcycle was tested recently at the Velodrome, New York City. It is said to have been the first American trial of rockets as a means of propulsion. The designer and driver of the cycle is Capt. George White, whose experiments in Florida with a wing-flapping flying machine were reported in *Popular Science Monthly*. He used a bank of ten rockets, mounted to fire to the rear and produce a succession of recoils to drive the machine.



This new electric broiler is said to cook a three pound steak in ten minutes, searing both sides at once. Place the steak in the meat griddle, insert in the handle and close the doors. By the time you have dressed for dinner it is cooked. The device plugs into the nearest wall socket. The heating element is removable for cleaning.

Inventions That Every Housewife Will Appreciate

Whoever thought of putting a handle on a pie pan? No doubt an oven or housewife who burned a finger pulling one of the old fashioned kind out of the oven. Anyway here it is, the pie pan with a handle that removes fear of dropping the pan or scorching the hands when the very trusted pastry is done.



The straight front edge of this new aluminum ladle is designed not only to get more food out, but to scrape the pot clean. It affords a wide contact with the bottom of the pan. At the opposite end is a handy hook.



The inventor of this aluminum orange juice extractor claims it gets the last drop. A turn of the handle completely reams the fruit, and the seedless juice is poured into a glass without spilling.



A miniature thermometer built into the top of a new waffle iron saves the first waffle, according to the maker. You can't spoil any, because you simply preheat the iron until the temperature is just right, then go ahead and bake. A temperature chart tells the right heat to use to get the best results.

Push down with your finger on the cover of the novel pin holder shown below and a pin pops out. No danger of pricking your finger for the device puts pin in your hand head up.



Gas range and gas refrigerator are combined in a new space-saving outfit for the kitchen. Stoves are saved by the convenience of storing food near the stove, and so efficiently is the cooling chamber insulated from the range, it is said that no heat leaks through to melt the ice.



The wavy tips of this under-frying fork are designed to prevent bacon and other meats from slipping off as they are removed from the pan. The fork has sharp, serrated points to aid in holding the meats. Wide slots allow the grease to drain from the meats as they are cooked. A long handle with a wooden grip keeps the hand away from hot fat.



Get this novel egg-timing alarm clock for "soft," "medium," or "hard" and when the eggs are done the word "boiled" flashes into view in the window. A bell rings at same time as a reminding signal.



Here are two electric household novelties—a percolator that makes either tea or coffee, using special immersion heater, and a special grill for toasting sandwiches. Coffee is brewed with a coffee basket and percolator tube; for tea-making this is removed and a tea ball is hung from the top. The toaster has expanding hinges.



Two coil springs supply churning motion to mix batter or whip cream in the jar. Once started, the two springs continue the motion.



A new metal clip holds the glass percolator top from falling off when you pour the coffee. The clip fits over the knob of the glass, and is fastened in place by bending its flexible ends under the rim of the lid.



Hang a clothesline around this wall hook, and the harder you pull the tighter it grips. The rust-proof holder is declared to be a positive remedy for sagging lines, and it eliminates bothersome knots.



This single electrical appliance makes the breakfast toast and coffee both at the same time. The heating element for grill and toaster are in the base of this new cooking device.



Between medicine cabinets built into the wall and hid by mirror doors are a recent home improvement. Here is the newest one with a double-hinged mirror that can be swung to any angle for the best light, or flat against wall.

Something new in holders for metal wool, used to scour pots, is the flexible rubber handle below. Bending back the sides exposes a safety-pin catch that is clipped through the wool and hooked.



The salt and pepper shakers at the right are useful for picnics as well as at home. A sliding guard keeps the contents where they belong, and is arranged to uncover either salt or pepper.





Left: Without touching controls, two pilots demonstrate remarkable stability of new safety monoplane. Note the unusual tail plane, and low main wing.



The latest creation of German builders is this army observation balloon, which can be converted into a controllable airship by addition of motor stabilizing planes, and rudder. Thus the big bag can move about, independent of the usual ropes to the ground. The upper picture shows the gondola of the balloon.



Creator of the new safety monoplane — Donald Hall, who also designed the famous *Spirit of St. Louis* for Lindbergh in recent years, his new ship (above) "flew itself" for long stretches up the Pacific Coast. Unusual features are its large lifting tail surface and omission of the stabilizing fin before rudder.



Captain Boykow, German inventor, with a new gyroscopic device which, he claims, will prevent gusts and bumps from tipping a plane off an even keel, and enable a pilot to fly without touching controls, says he has gained altitude. Ocean flyers Chamberlin, Kochl, and Fitzmaurice are said to have tested planes using the device.



Three blades, instead of two, whirl at the nose of a new Boeing biplane recently tested by Erik Nelson, 1914 Army round-the-world flyer, to discover whether extra blade will increase speed and enable a plane to rise more quickly.



Here's the latest view of the remarkable steel all-metal dirigible, first of its kind, nearing completion in its hanger at Glendale, Calif. The ship, 213 feet long, has a shell of corrugated sheet duralumin. The upper picture shows ingenious elevator in which passengers are to be lowered from the hovering ship along a rope passing through center.



Climbing seven miles above McCook Field, Ohio, Captains St. Clair Streett (right) and Albert W. Stevens, U. S. Army altitude flyers, recently took photographs of the city of Dayton below. It was a record. They are shown at left with their equipment, including heating apparatus in foreground.

A PHANTOM airplane designed for war use and said to be practically invisible in the air is nearing completion at Nottingham, England. Recent tests showed the possibility of constructing such a plane, on which it would be impossible for enemy gunners to train artillery, as reported not long ago in *POPULAR SCIENCE MONTHLY*. Now the British government is building the first of these war terrors.

It is made entirely of "glass"—a material of secret composition which looks like glass, can be handled like metal, and will stop bullets. Even the pipes for gas, water, and oil are of this material. An observer seeing the machine on the ground would rub his eyes and imagine himself gifted with X-ray vision. He could see right through all parts but the motor, control stick, and wires, which are of conventional material. Against the sky, only a hum will betray the plane's approach.

More Records Smashed

NOTABLE airplane records marked the last month in aviation.

An unofficial world's record for speed went to Flight Lieut. D'Arcy Greig, British pilot, who flew his supermarine Napier seaplane at an average speed of 319.57 miles an hour off Calshot, England, in four consecutive dashes over a standard course. Since Greig failed to exceed the previous mark by five miles an hour, Major Mario de Bernardi of Italy still holds the official world's record of 318.62 miles an hour.

What is believed to be an unofficial speed record for commercial transport planes was set by an American passenger craft, of the Western Air Express, which averaged 177 miles an hour on a 365-mile flight between Oakland and Los Angeles.

The world's altitude record for a plane carrying two men, it was recently disclosed, belongs to the two U. S. Army flyers, Capt. St. Clair Streett and Capt. A. W. Stevens, who recently climbed to 37,854 feet—within 600 feet of the world's free-for-all airplane altitude mark—to take air pictures. A French flyer, Pierre Le Moigne, went after the altitude mark the other day and narrowly missed death when he fell six miles out of control. He landed safely but without the record.

A Great Seaplane Harbor

SOON Montreal, Canada, is to have one of the finest seaplane harbors in the world. Two 300-foot breakwaters built out into the St. Lawrence river from

points of land along the shore will inclose a body of smooth water nearly a mile long and half a mile wide—plenty of room for seaplanes to land and to take off. Arriving aviators and passengers will disembark on two floating platforms, provided in addition to mooring places for the planes.

Flood lights and air beacons will be

expected to reduce motor noise. Sound-proof cabins with walls lined with balsam wood shavings are being used experimentally in Fokker planes, and the U. S. Bureau of Standards is trying out a similar cabin under the direction of Dr. Paul Heyl, in charge of sound experiments at the Bureau. The cabins would also stop propeller noise, a sound almost as loud as the motor.

First to Fly in Antarctic

WHILE Commander Byrd and his scientific expedition were sailing toward the Antarctic, a famous explorer already there scooped away the honor of being the first man to fly a plane over the south polar region. Sir George Hubert Wilkins, who recently arrived at his base on Deception Island, Antarctica, announced that he had already piloted one of his Lockheed planes on a short flight in preparation for his projected air trip along the coast of Graham Land. He hopes to find a possible site beyond the Ross Sea ice barrier for a polar meteorological station.

Planes Wear Life Buoys

LAND planes can leave the deck of an airplane carrier for a shore visit when the sea is too rough to launch a seaplane. But should the land craft fall into the sea the plane may be lost and its crew drowned.

So the Navy recently has adopted a unique "floatation gear" to turn a land plane into a seaplane

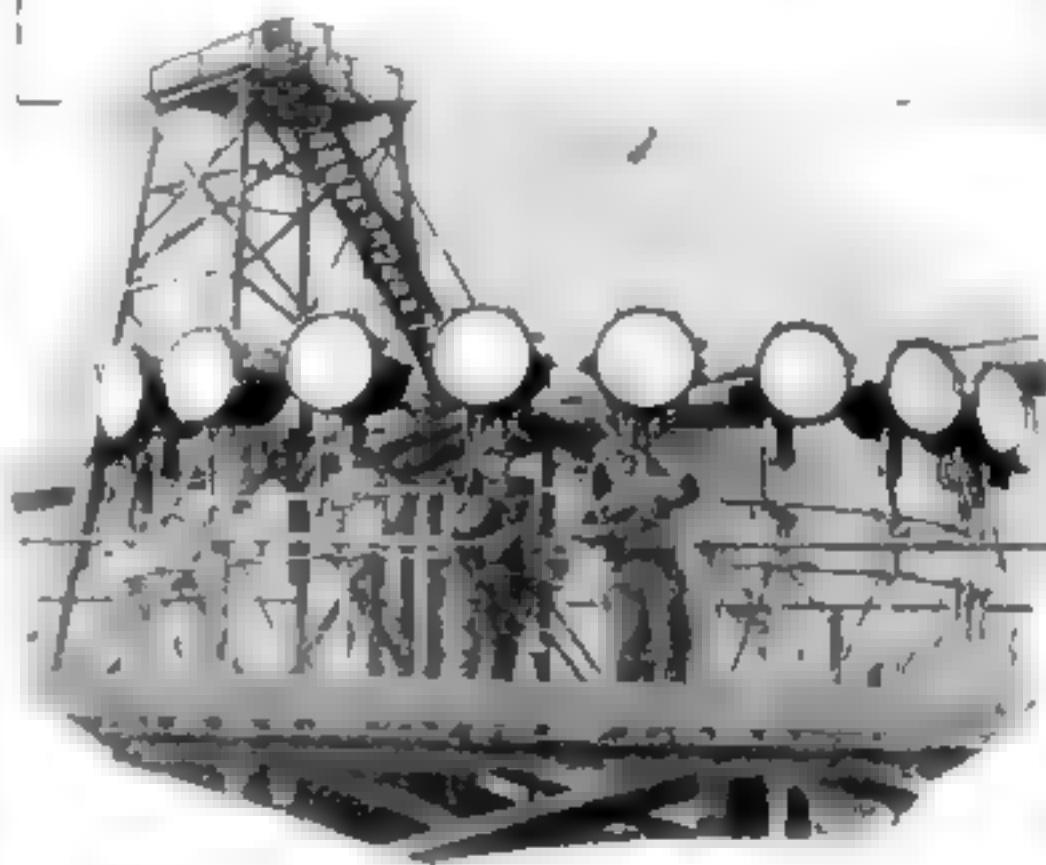
in an emergency. Two built-in compartments in the nose of the plane, and one in the rear, house barrel-shaped bags of gas proof fabric, normally folded. But when a forced descent on water is made, the pilot pulls a lever that instantaneously inflates the three bags like balloons, from a steel bottle that contains compressed gas. With these balloonlike pontoons, a plane can float indefinitely.

A recent improvement in the device inflates the bags automatically, should the plane touch water. The entire equipment for a large bombing plane weighs only seventy pounds.

New Gun Sprays Bullets

SPRAYING bullets from a machine gun, just as water is sprayed from a lawn sprinkler, is the purpose of a unique invention under consideration by the War Department for use in fighting planes. According to the inventor, Joseph F. Butler, of Pittsburgh, it makes it unnecessary to aim a machine gun accurately, no hostile (Continued on page 132)

STRANGEST of New Fighting Planes Is an Unseen "Ghost" of the Air—Other Astonishing Inventions and Records Mark the Month's Progress in Flying



Here is one of two huge semicircular batteries of searchlights which turn night into day for flyers landing at the new Newark, N. J., municipal airport. In all there are twenty-two of the floodlighting lamps, each of a million candlepower.

installed for night flying. Visitors will see customs and immigration buildings, as well as restaurants and waiting rooms. The project has been approved by the Montreal Harbor Commission and the Department of National Defense.

Silencing Roar of Planes

TURNING the roar of a 200-horsepower air-cooled motor into a mere hiss is the feat claimed for a new silencer developed by the makers of Fairchild planes. The invention, perfected with the aid of the Maxim Silencer Company, is a six-foot pipe as thick as a forefinger, which runs from the motor back under the cabin. It contains a metal spiral which is said to break up the sound waves without reducing power.

Other devices have recently been demonstrated to quiet airplanes without stealing power or adding to fire hazard. The U. S. Navy is experimenting with an apparatus that passes exhaust gases through the vacuum of the propeller's stream, and the changed rate of flow is

The Real Fathers of Flight



Wilbur and Katherine Wright flying before King Edward VII of England at Pau, France, in 1909. The King is at right of derrick. In foreground, facing the camera, is Orville Wright. Little did the Wright boys dream that injuries to Wilbur in an over "shabby" game would lead to world triumphs.



How Two Untutored Bicycle Men Conquered the Air After Learned Experts Had Failed—The Amazing Story of Wilbur and Orville Wright, Told for the First Time in Intimate Detail

By JOHN R. McMAHON

I HEAR the Wright boys are going camping this summer," said a citizen of Dayton, Ohio, to a neighbor in the year 1900.

"That so? Making money out of their bicycle business, I guess. Where are they going?"

"Queer place called Kitty Hawk, down in North Carolina."

"Why do you suppose they want to go that far?"

"I wonder myself. Wilbur went into a store yesterday and bought a lot of sateen cloth—twenty-five yards of it. Girl says, 'What do you want it for?' He says, 'Well, I want it.'"

"By George, I know! Those Wright boys are real original. They want to start a hunting and fishing camp—charge people money to belong—and that sateen cloth is to make tents and beds."

"That's it," agreed the other.

Maybe it was just as well the gossipers did not suspect that the cloth was required for wings on a flying contraption or man-carrying glider which the Wrights were to try out late that summer at Kitty Hawk.

It had taken Wilbur and Orville four years of pondering and minor ex-

periment to create this, their first man-size model of the future airplane, and to test it for the first time in the air. They were humble beginners. They little dreamed that within three years at Kitty Hawk they would become the world's first navigators of the air and that in

result of such achievement they would be received as honored guests by the rulers of five continents, and the possessor of three own land—France.



Wilbur, age thirteen, top, and Orville, age eight, bottom, building their own printing press and working with tools gave them invaluable training for inventive work.

little imagined that less than ten years later they would be shooting away a king, a crown prince, and multitudes galore who begged for a ride in their sky vehicle; that the King of Spain would be arguing why he should be a passenger when the Queen was not looking; that the Crown Prince of Germany would be pleading for a short trip which you and I now obtain for three to five dollars.

HOW did the Wrights—uneducated—dare to attempt what they did? I have heard dozens of people ask that question. Here were two modest bicycle mechanics, without funds and with very little schooling, essaying to compete with trained and learned men of science in the development of an epochal invention. While the Wrights were just beginning their study of flight as the merest novices, it seemed that men like Clement Ader in France, Sir Hiram Maxim in England, Octave Chanute and Professor S. P. Langley in America, were past masters in the study of aviation. They had built gliders, written learned books, made model gliders fly, and some of them were at work on ponderous power machines. They had prestige, money, and apparent science. Maxim was the famous inventor of the Maxim gun. Chanute was a leading engineer. Langley was secretary of the Smithsonian Institution, a Government museum and scientific laboratory.

And yet the unschooled bicycle men of Dayton, outdistancing all learned rivals in the world, succeeded in their quest,

and created the first airplane from which are directly derived, without basic difference or change, all the mighty fleets that roam the sky today.

How did they ever manage to do it?

For an answer, let us go back a few years, to their boyhood and youth in the simple little homestead on Hawthorn Street in Dayton, and see how the brothers qualified themselves to succeed where men of far greater technical learning and resources failed.

THE Wright family was settled in Dayton permanently in 1884. Nightly after supper the two boys, Wilbur and Orville, toiled at the dining room table with the tools of wood carving and engraving. They turned out some useless things but advanced in the knowledge of tools. The younger brother surpassed in his deftness with chisel and graver. Wilbur's ability showed in a substantial chair which he built for his aging mother.

This boyish indoor amusement was, in effect, part of a course in draftsmanship and woodworking that became a prime advantage in the future creation of gliders and then a power flyer. Thus the boys learned to draw plans to scale—whether a wing, motor, or propeller—and how to execute them in detail. There was more wood than metal in the first aircraft, and it was well they early learned the difference between ash and oak, pine and maple. This was a profitable home schooling that the Langleys and Maxims missed. A home workshop does not make everybody a great inventor, yet it develops and edges with.

"**T**HE Wrights are their own mechanics and won't let anybody do anything for them," was the amazed critical comment in later years amid their triumphs abroad. It was partly the reason, too,



The former Crown Prince of Germany pleading with Orville for a ride in the air. A few years before as Wilbur read books on flight to his sick brother their wildest fancies did not picture themselves as being sought after and honored by princes and presidents.

for their epochal achievement.

Wilbur took a year's course in the Dayton high school in 1884-5 to supplement his previous schooling. Science, mathematics, and history were the subjects he studied. His academic record seems barren, but his athletic activity led to an accident without which the world would have had no airplane today.

A fellow player, in a game of shinny on the ice, accidentally struck Wilbur on the mouth with his stick, knocking out all his front upper teeth. It was a cruel injury. A surgeon bandaged the gory face.

"I'll walk home," we can hear the brave lad mumble. "Scare mother if I didn't." He had his way and walked.

How could this boyish misfortune pro-

mote a world discovery? Among the effects of the injury were heart and stomach trouble. There was a long period of delicate health, if not semi-invalidism. The effect in poor health kept Wilbur at home for years. He did not travel or marry, like his elder brothers.

THE age difference between himself and Orville was equalized, making possible their collaboration in inventive feats, which they continued to a triumphant end.

Orville was fourteen and in the eighth grade of public school when he formed a partnership with another boy in the printing business. The partner was Ed Sines, a crony from early childhood. The print shop, in the Sines kitchen, was equipped with a toy press, a bellbox of junk type, a few wood engravings made by Orville, and some of Mrs. Sines' embroidery stamps, all very useful in printing and decorating a catalogue.

For the Wrights, printing became a needed enlargement of mechanical talent on the

road to the flying machine. It also developed into a practical source of bread-and-butter. Father Wright cheered the struggling partners with a donation of twenty-five pounds of second-

hand brevier type at the same time he prompted Wilbur and Lorin to trade their jointly owned rowboat, which Wilbur had built, for a real press to be presented to Orville. This press was 8 by 8 inches, self-inking, famed as the "Model." When the partners added to this outfit some job type, they were soon emboldened to launch a school paper, styled the *Midget*.

At sixteen, Orville decided to build a printing press. He took sticks from the family woodpile and shaped them on the turning-lathe that had been earlier conjured from a similar stack of kitchen stove fuel. A junk shop supplied a metal roller which only needed a gravel filling for weight and plugging of the ends with wooden disks. After inking a form of type on its flat bed, a sheet of paper was set in place and subjected to the pressure of the gravel-loaded roller. It worked. But Wilbur cast his eye on the outfit and saw how it could be bettered.

WE CAN imagine the youthful Wilbur saying:

"This press is all right, Orv, but it would save work if you didn't have to run up and down with that big roller. Look, I'll fix a lever to shoot the roller back and forth. Then you just stand and move the lever with one hand."

The elder also helped on a tympanum device, and the pair coaxed some speed out of the woodpile press with Orv at the lever and Wilbur inking and feeding. Later they devised and built an ingenious mechanism that folded printed papers as they came from the press.

All this was typical of the collaboration between the brothers. The younger, full of eager visions, began projects which



King Alfonso of Spain, left, shown arguing with Wilbur why he should be given a ride in the Wright plane when the Queen was not looking. Wilbur showed him how the machine worked, but turned him down as flying.

The Wrights printing the first issue of the *Midget* in 1887. The press was a toy press, the type was junk, and the ink was made by Orville.



At sixteen, Orville built a printing press out of stumps from the family woodpile.



The Wright brothers' bicycle shop on Third Street Dayton, a "kindergarten" where they acquired craftsmanship to build the airplane.



Left: Orville as he appeared in 1896 at the time when the brothers began studying flight.

were scrutinized and improved by the elder. Thus, if we should tag the essential parts of the airplane with the initials of the joint creators, indicating priority of concept and improvement, the results would be:

Wing warp or flap for sidewise balance, O, W; vertical rudder for sidewise balance, O, W; horizontal rudder for fore-and-aft balance, W; wing curve, O, W; propeller curve, simultaneously W and O.

IF, AS boys, the Wrights were able to build a rather intricate machine out of nothing, we can understand how in manhood they assembled hack saw blades and other junk in a bicycle shop to create the world's pioneer device for the correct measurement of air pressure that was a prerequisite to the solution of the flight problem.

When the brothers resolved in the late winter of 1888 to publish a weekly newspaper, they wanted a simple printing press. Imagine Mrs. Wright looked with dismay on the family woodpile, for the weather was cold. But the press was needed. It was the most ambitious of the inventors' efforts up to this time. A secondhand tombstone served as a flat bed for the press. There was a massive roller and an amplitude of wheels, pulleys, gears, and levers.

"Every part of this press ran at full speed," a member of the family told me. "It was the liveliest thing you ever saw. The racket it made was terrible."

The *West Side News*, printed on the new press, made its bow to the public in March, with Wilbur as editor and Orville filling the position of business manager.

The boys' mother died on July fourth, 1889. She left her sons a rich legacy—skill of hand and eye of her craftsman parent, original minds, the example of her own ability to create, and her sympathetic encouragement of their childish and boyish play-steps toward the making of dreams come true.

If that mother could have seen in a magic crystal of the future her sons standing in the White House, receiving gold medals at the hands of President Taft—Wilbur and Orville striding down a field with the King of Italy between them—Wilbur a fight with his sister Katharine in

the presence of His Britannic Majesty Edward VII—Orville smiled upon by an emperor and cheered by 200,000 massed spectators of whom many sought to touch the hem of his garment—would she have shook her head or with a startled gasp, weeping, have believed? There is no limit to the hopeful imagination of a mother! She would have believed. And taken more joy in their useful service to the world than in the pomp and glory which attended their success.

With the eldest son married and the next permanently away, the home was reduced to three children and a father often absent on church trips. Fifteen-year-old Katharine tried to be a "little mother" to Wilbur who was twenty-two, and Orville, who was eighteen. The trio became inseparable through the years, unbroken save by the intervention of death. No one else was as close to the inventors as this sister, their beloved "Storchena," who was their comrade and perfect confidante.

IF THE muse of history raised a polite eyebrow because Wilbur did not graduate from high school, let her now lift the other eyebrow! Orville did not graduate when he left Dayton high school in 1889. Thus neither of the brothers even finished preparatory schooling. The Wrights never went to college.

The *West Side News* was turned into a daily in the spring of 1890 under the name of *The Item*. A funny column styled

"Predictions by the Weather Prophet" was included among the tasks of Editor Wilbur. Orville's job was to make big merchants sign on the dotted line.

The *Item* luckily died in three months and the relieved owners turned to job printing. In the output of Wright & Wright, Job Printers, were pamphlets up to 100 pages, minutes of the United Brethren Church, and a journal for colored people. The latter was edited by Paul Lawrence Dunbar, a young negro who had been Orville's classmate in high school.

DUNBAR was given to original poems which he recited in the print shop. One day he scribbled on the wall an effort that is doubtless omitted from the collection which brought fame to the Afro-American poet. But it has an interesting touch of appreciation, if not prophecy.

Orville Wright is out of sight
In the printing business.
No other mind is half so bright
As his'n is.

The Wrights were as pleased with Dunbar's later success with his *Pegasus* of poetry as he was over their feat with a mechanical steed of the air. The brothers were strong in loyalty to early and old friends.

The job printers branched out in 1892 with the addition of a bicycle repair shop to their line. No doubt they were lured into this by the idea of playing with a new machine, the ball bearing "safety" with compressed air within rubber tires. "Wright Cycle Co." was the legend put above the modest shop on Third Street. That sign remained blandly unchanged through the years, long after the proprietors had advanced their activities from the creation of ground to aerial vehicles. It is interesting to consider that the bicycle trade was a kindergarten to many who later found fame and fortune in automobiles and aircraft. For the Wrights it was a real stepping stone toward the

(Continued on page 158)



After success had come—the inventors' father (center), with Orville at his right and Katharine, seated with friends on the lawn of their new home at Dayton. John H. McMahon, the author, can be seen beside Orville.

Tides Make the Earth Boil Over

By EDWIN W. TEALE

RECENTLY the world read that thousands of refugees, carrying pitiful bundles of salvaged goods, were clogging the roads of eastern Sicily, fleeing from an eruption of Mt. Etna. For five years this 10,758-foot volcano, fringed with villages and vineyards at its base, had been quiet. Then Vulcan's forge flared anew.

From an opening in the side of the mountain which, strangely enough, remained covered with snow at its top—there crept a devastating dragon of fiery lava sixty feet high. Dividing into three streams, it advanced down the mountain-side, devouring trees and buildings in its incandescent flood, and pushed ahead for fifteen miles toward the Ionian Sea. When, after twelve days, it had run its course, a town and two villages had disappeared, 7,000 people were homeless, and 10,000 fertile acres had turned to ridges of stone. Etna had again proved its right to the crimson dot that marks it on the map!

If you look over a detailed map of the world you will find three or four hundred of these red dots, each marking a volcano of comparatively recent activity.

Not all active volcanoes erupt, as did Mt. Etna, like a boiled-over pot. Many explode, shooting dust and ashes miles into the air. The nonexplosive character of Etna is ascribed by volcanologists to the fact that its lava is a relatively thin liquid which allows steam and gas bubbles to escape readily. In explosive volcanoes, the lava is thick. It holds back steam and gas stubbornly, causing immense pressure beneath, and eventually a violent eruption.

A FEW years ago, scientists discovered the strange fact that lava is hotter at the surface of a crater than in its interior! Dr. Arthur L. Day, director of the geophysical laboratory of the Carnegie Institution, Washington, D.C., descended to the very floor of the fire pit of Kilauea, in Hawaii, wearing a gas mask as protection against the poisonous fumes. With flames shooting all about him, and the heat charring the soles of his heavy shoes, he took measurements which revealed that twenty feet below the surface of the lava the tem-



E. S. Mather, Courtesy Dr. T. A. Jaggar

With this terrific explosion not long ago, Mt. Kilauea in Hawaii, normally tranquil, went on rampage. As volcanoes age, eruptions are less frequent and more violent.

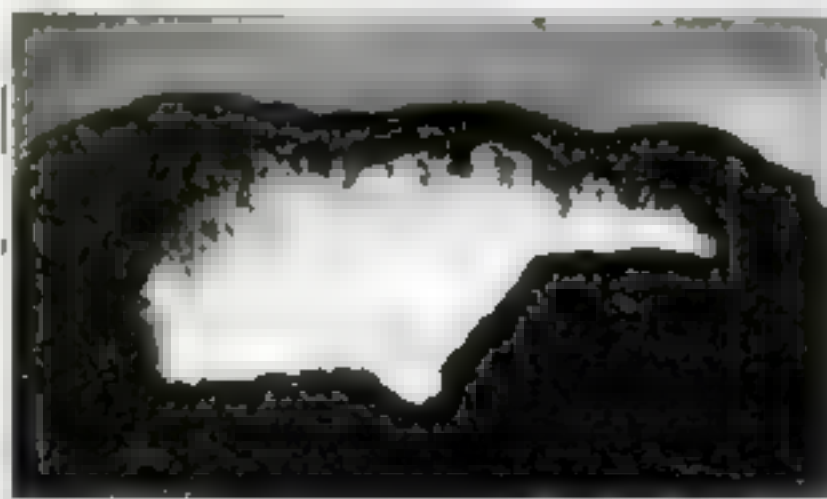
perature was 100 degrees C. lower than on the surface. One explanation is that one third of the gas from the crater is hydrogen, which burns at the surface, increasing heat.

As volcanoes grow old, their eruptions become less frequent and more violent. Etna is comparatively young, possibly not older than 100,000 years. The most destructive of the fiery mountains are tranquil for long periods. Hondoan, in Japan, was quiet for 1,000 years before its outbreak in 1868. Vesuvius, most famous volcano in the world, was described as being verdure-clad before it belched death upon Pompeii. The most terrible of all known volcanic disasters occurred on the Island of Martinique, in 1862, after Mount Pelée had slumbered for fifty years. A single puff of its fiery breath snuffed out 40,000 lives in the city of St. Pierre. A single human being remained alive through the disaster—a negro prisoner locked in an underground dungeon.

At one time it was believed that all volcanic lava came from a central reservoir, formed by the molten heart of our globe. Now, however, the earth's interior is believed to be more rigid than strongest steel. Instead of being of deep-seated origin, volcanoes are now thought of as a "skin disease" of the earth. Lava is believed to originate at moderate depths, which Charles F. Talman, of the U. S. Weather Bureau, says probably never exceeds half a dozen miles. Some volcanologists hold that lava is carried by rootlike channels running around the earth; others that small individual pockets or reservoirs of molten rock are formed beneath each crater.

(Continued on page 11)

Left: Mt. Etna's latest eruption. Below: Refugees fleeing down the side of the mountain.



A seething caldron of molten lava. This spectacular night photograph shows a vent in Kilauea after a violent explosion. The interior is white hot and hung with glowing stalactites. Scientists, wearing death masks to measure heat in Kilauea's fire pit, have found the lava hotter at the surface than in crater's interior.

Planes Bomb "Warship" on the Desert

**Life-Size Dreadnaught,
Painted on Sand, Blown
to Bits by Shower of
Missiles from the Air
in Amazing War Game**



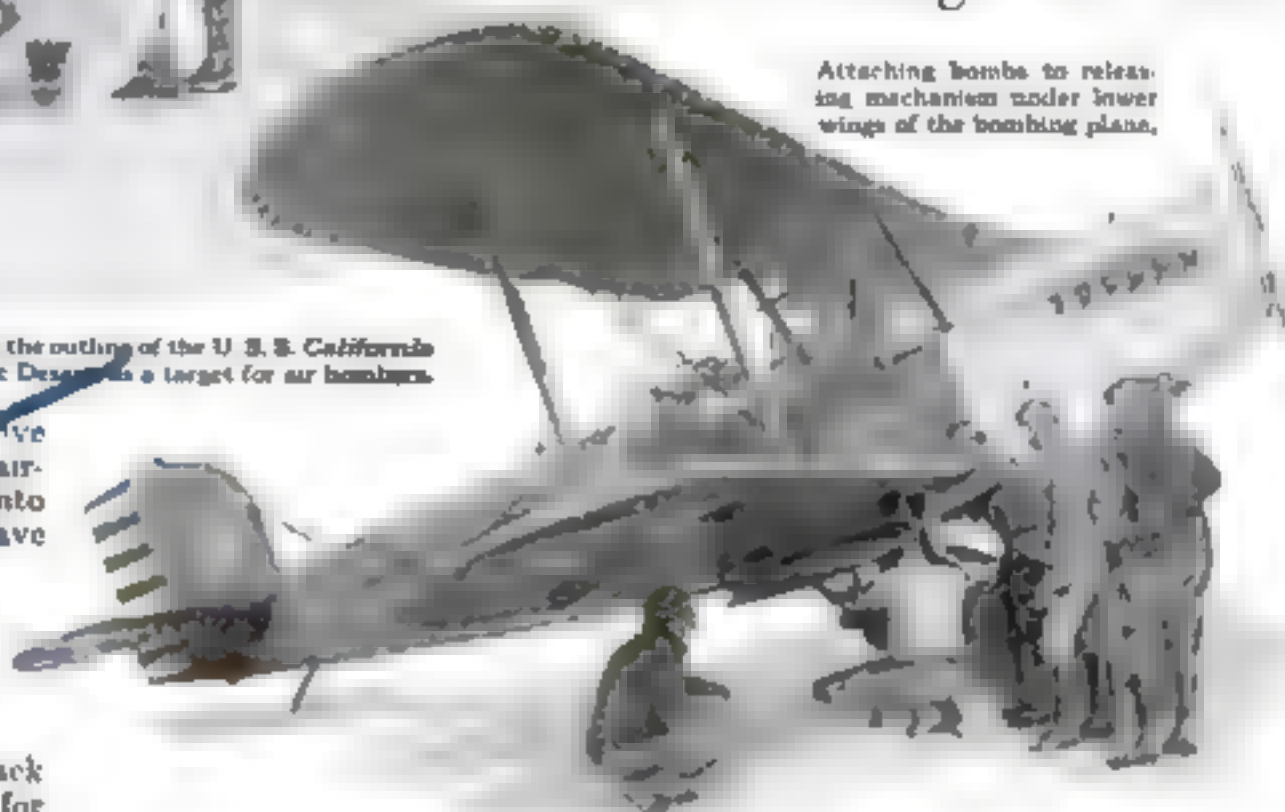
California National Guardsmen painting the outline of the U. S. S. *California* on the glaring white sand of the Mojave Desert as a target for air bombers.

WITH whining steel propellers, five California National Guard airplanes recently wheeled into position over the shimmering Mojave Desert and released a series of high-explosive bombs in a new type of practice maneuver. On the bed of a dry lake below, the exact outline of the U. S. S. *California*, painted to scale, had been shaped by guardsmen, using black crude oil for paint, and brooms for brushes. Even the turrets and big guns of the naval giant stood out exactly reproduced in size by the black oil upon the white alkali covered desert floor.

Toward this strange battleship of sand the speedy war planes discharged their bombs—thirty two in all. As each struck,

it detonated with a roar, raising a huge cloud of smoke and dust. Three of these death-dealing bombs struck at almost the same time, all landing within the lines marking the deck of the dreadnaught.

When the flock of war birds headed back for the home field, the outline of the ship had been blown to pieces and its position was marked by a series of holes torn by the exploding bombs.



Attaching bombs to releasing mechanism under lower wings of the bombing plane.

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Now You Can Eat Sunshine!

Here Is the Story of a Man Who Gave Away His \$1,000,000 Discovery to Make Folks Healthy—How the Sun Is Being Put to Work

By

FRANK PARKER STOCKBRIDGE

Prof. Harry Steenbock, of the University of Wisconsin, who discovered that food bathed in sunlight will aid in preventing disease, and prevented mankind with amazing new health cereals.



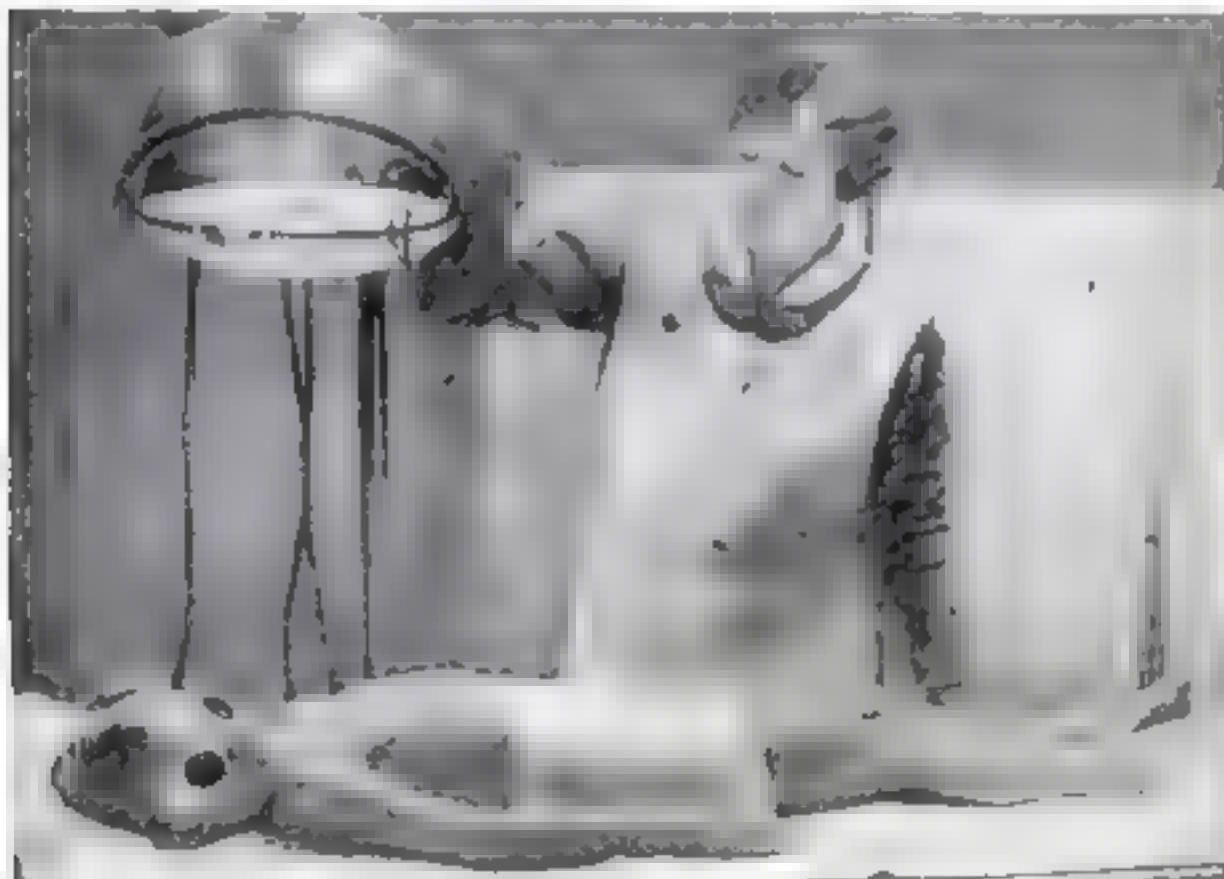
WITHIN the last few weeks a new breakfast food has appeared on the shelves of grocery stores throughout the country. During its making, it has been bathed in artificial sunshine from high-powered electric lamps. It is the first of new "irradiated" health foods that you may soon expect to see upon your grocer's shelves. And it is the first result of a sensational process that might have been worth a million dollars or more to a University of Wisconsin professor, had he not preferred to give it away.

When Prof. Harry Steenbock, the originator of the process, made his astounding discovery that sunlight-

bathed food will prevent rickets, dread bone disease, and will probably help to check tuberculosis and anemia, he feared that his knowledge might fall into the hands of unscrupulous profiteers. So he snatched off the powerful sunlight lamps in his laboratory, put back in their cages the white rats that had led him to the epoch-making find, and applied for a patent. When he obtained it, he presented the food-making process, patents and all, to the University of Wisconsin.

Great manufacturers of food products heard of the discovery, came to Steenbock, and were referred to the University's trustees. There they learned that they would be licensed to use the sunning process, provided they did not increase the price of their product because of it. Several important firms accepted the opportunity, one of them now paying the University \$50,000 a year for its license. Now the first of the new products, an irradiated cereal, is being produced commercially. Others are to follow soon.

By setting "sunburned" food, everyone by proxy at least, can now bask in the sun's rays that our distant ancestors once worshiped and that our modern physicians have found vital to health.



In a Chicago hospital, crippled children suffering from bone tuberculosis are treated with artificial sunlight from ultra-violet lamps. Here one of the small patients is having his sun bath.

SOME day science will find out definitely what influence the light of the sun, particularly the ultra-violet rays, which Dr. Steenbock and others produce artificially with their so-called "sunlight lamps," has upon human life, and how and why. The Incas of Old Peru, the ancient Zoroastrians and their successors, the Parsees of today, and many other religious cults, have held that all life comes from the sun, and modern research seems to be proving that they were right. We have long used the expression "a healthy tan," in referring to the darkening of the skin by exposure to sunlight. The knowledge that this burning of the skin is done by invisible ultra-violet rays is very recent; still newer is the discovery that these ultra-violet rays carry into the body life-giving properties to which the name of vitamins has been given, newer yet is the knowledge that unless we take these vitamins into our bodies with our food, as well as getting them into our systems through our skins, we cannot live healthily nor very long.

Women are beating the male sex to it in the application of this aspect of science



Making artificial sun. Here is a view of the apparatus used by the U. S. Bureau of Standards to produce artificial sunlight.

to life. Dr. Ephraim R. Milford, president of the New York Medical Society, told a convention of doctors the other day. Arrogantly they are healthier and longer lived than men more resistant to disease and more resilient under strain. Dr. Milford attributes this to the modern fashion of wearing fewer and looser clothing. They expose themselves to the life-giving ultra-violet rays, whereas men persist in covering their bodies from neck to ankle with thick, dark clothing. The whiter and more porous the material of our clothing, the more easily do the ultra-violet rays of the sun penetrate to the skin, the United States Bureau of Standards reports. Dyed fabrics, and even those slightly yellowed by age, shut them off almost completely. The one-piece bathing suit or the still scantier costume of the Oriental dancer would seem to be more in line with what Nature intended us to wear!

WE DIG our graves with our teeth by rejecting the vitamin-bearing foods in favor of sugar and starches, says Dr. Seale Harris, of Birmingham, Ala., in a report to the American Medical Association. Lowered resistance to infections of all kinds, in the nose and throat as well as in the stomach and intestines, results from a diet consisting mainly of white flour bread, white potatoes, white rice, lean meats, sugar-saturated coffee, sugar-laden desserts, sweetened soft drinks, and candy, says Dr. Harris, comparing the increased prevalence of abdominal disease with the increase in sugar consumption.

Fifty years ago the average person ate twenty-six pounds of sugar a year; now he eats 100 pounds. Frequent colds, pneumonia, tuberculosis, appendicitis, stomach ulcers and gall-bladder disease are attributed to lack of vitamins in the diet of the average sedentary American. Catch your own food and eat it raw and you will get all the vitamins you need. The human machine functions best when we eat only what we can capture, pluck



An expert of the U. S. Bureau of Standards tests the proper weight of cotton and rayon cloth to admit the health-giving ultra-violet rays.

or dig barehanded, combining muscular effort and exposure of our bodies to the sun with a diet which is rich in vitamins because it, too, has been exposed to the sun.

Since that mode of life is impractical in our industrial civilization the best practical compromise is probably to eat a much higher proportion of fats, nuts, raw fruit, and green vegetables, wear the lightest clothes we can tolerate, walk in the sunlight as much as we can, and trust to luck.

WHILE Prof. Steenbock was feeding cereal to white rats in his darkened mid-Western laboratory, other experimenters here and abroad were bottling sunshine for human needs. From laboratories in England and Germany came the news that a substance had been discovered which, exposed to sunshine, or ultra-violet light, became a remedy thousands of times as potent as cod liver oil. Six ounces of it equal a ton of the fish oil, it is said. Known as ergosterol, this substance, formed from yeast and activated by sunlight, is present in small quantities in every healthy person. But let it be lacking, and a dose so small that it could hardly be measured would remedy the trouble. So powerful is this substance that an overdose of a few grams might prove deadlier than arsenic.

How this magic substance was found is in itself an absorbing story, that started with efforts of scientists to make

cod liver oil more pleasant to take. The first attempts to make the oil palatable, by purifying it, destroyed its curative value. That gave the first clue; perhaps the beneficial ingredient was actually an impurity. Prof. George Barger, of the University of Edinburgh, pursued this clue and found the answer—the whole medicinal value of the oil was confined to ergosterol, which is found as an impurity in fats.

THEN Dr. Adolf Windaus, a German expert of the University of Göttingen, proved that by exposing ergosterol to sunshine or to ultra violet light could obtain a substance with curative power of cod liver oil. For that discovery he has been awarded the Nobel Prize in chemistry for 1928, a cash award of more than \$40,000.

In other words, cod liver oil owes its beneficent effect wholly to an impurity—which, in turn, owes its power to sunlight that filters through the water to the swimming fish.

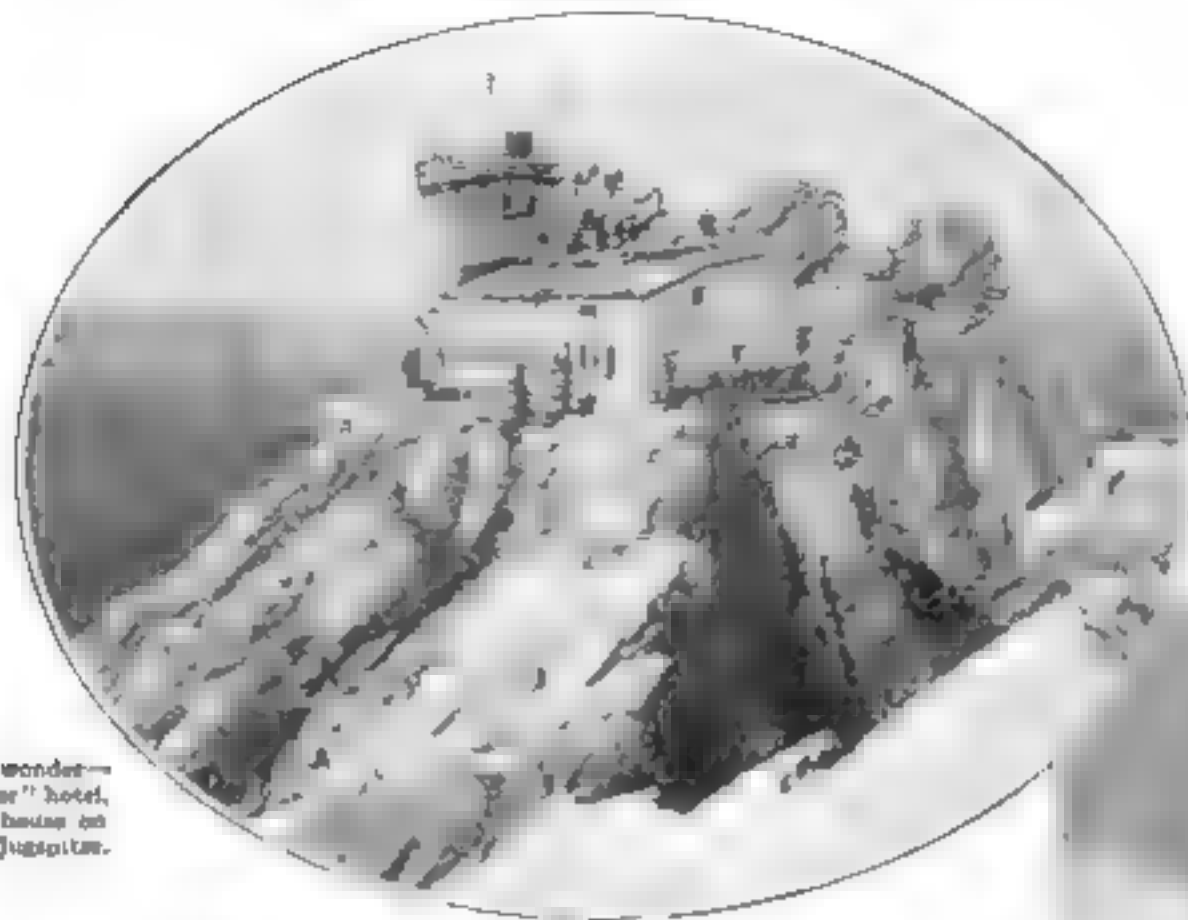
When sunlight hits ergosterol, it turns it into "vitamin D"—one of those mysterious, necessary components of foods which scientists now believe owe their health-giving potency to the fact that they absorb and retain sunshine. Vitamin D, which is the rickets-preventing vitamin, is manufactured

in the human body by an interesting process which scientists are just now beginning to understand. Ergosterol, already contained in the body, finds its way to the surface of the skin, where it is bathed in sunlight. Then it is reabsorbed with its health-giving vitamins. It is because it is in this process that cautious bathing in the artificial sunshine of available electric lamps is now recommended by medical men, who also believe that people whose bodily "sun-bottling" apparatus is defective can make up the deficiency in an indirect way by eating food that has been treated with sunshine.

TO DEMONSTRATE that sun baths can be taken in food, Professor Steenbock raised two broods of white rats.

One brood he deprived of a part of their normal diet, and they developed the bone disease of rickets. The other brood he sun-bathed daily in the artificial light of mercury lamps. At length he killed the rats of the second brood and fed an extract of their livers to the undernourished ones. The ricket-afflicted rats became healthy again.

Thus he proved that treatment with ultra-violet rays could be given indirectly, in food. Next he exposed quantities of flour and farina, rolled oats and other cereals, to the powerful rays of mercury lamps and fed them to ricket-afflicted rats. These rats, too, recovered. Then Professor Steenbock announced his discovery of how to put healthful sun- (Continued on page 158)



A new engineering wonder—the tiny "sleeping car" hotel, perched like a bird house on the pinnacle of Zugspitze.

Going up! The little car, hanging on an aerial cableway nearly two miles long carries guests to the hotel.

Sky Railway Runs to Strange Hotel

TWO great engineering feats were combined recently in a single enterprise that may be numbered among the wonders of the world. One is the famous hanging-car aerial cableway that climbs to the top of Germany's highest mountain peak, the Zugspitze, more than two miles above sea level. The other is the construction of the world's loftiest all-year hotel, perched on a sharp crag that forms the very pinnacle of the mountain. The second was made possible by the first.

The hotel, a Lilliputian hostelry smaller than a regulation-sized sleeping car, probably involved more problems of construction than the largest hotel ever built. It was designed like a sleeping car, not to be fantastic, but because of the meager space available, and also because of the difficult

A thrilling ride if you don't get dizzy. At right is the hanging car, with load of passengers, near the mountain top.



Almost like the sheer wall of a skyscraper is the rugged mountain-side.

and dangerous task of lifting materials to its lofty perch.

A landing place near the summit, used by the hanging-car cableway, gave rise to the audacious idea of providing a modern-equipped mountain-top hotel. The cableway, first of its kind, extends from a station in Austria, 2,800 feet above sea level, up 11,000 feet to the mountain's summit.



The tiny "sleeping car" took six months in building. The first task was to break up 2,500 cubic yards of rock to make a suitable foothold for the hotel. Wood construction was used because of the drastic change in temperature, which caused enormous expansion and shrinkage of material, and because cement froze before it could be used.

Storms, snow, and ice greatly hampered the work. The peak was swept by a seventy-mile gale and in winter the thermometer dropped to zero and below. The crews of eighty men had to be changed from week to week, so gruelling was the task. Three men were lost; one fell into a chasm and two were caught in snow slides.

All building materials, machinery for an electric power plant, furnishings, heavy porcelain plumbing and pipes, furniture and equipment for a restaurant capable of serving 250 hungry guests at a single meal, pumps for a reservoir, a large steam heating plant, food and fuel for the workmen, and finally the workmen themselves, had to be hauled up the rugged mountain sides or carried in the tiny cable cars that hold only twelve people and take twenty minutes for each trip!

There are berths for seventy-three in the "sleeping car." First-class bedrooms are "outside," with windows looking upon the magnificent view below.

The total cost of the Zugspitze cableway and the hotel was about \$1,000,000.



Standing on the balcony high above the clouds, visitors at the tiny mountain-top hotel are thrilled by the marvelous bird's-eye view of mountain tops and valleys below.

Along the Road of Progress

EVERY shade and tint can be reduced to a numerical formula, expressed in figures, by means of a device known as the recording spectrophotometer, recently invented by Professor Arthur C. Hardy, of the Massachusetts Institute of Technology. The apparatus automatically analyzes the light rays reflected from any object of any color and records in ink, on a chart, the precise proportion of each of the primary colors, red, yellow and blue, which combine to make the shade under observation. The chart reading is easily reduced to figures, so that it is possible to describe any color or tint in numerals which will enable anyone having access to one of Professor Hardy's instruments to match it perfectly without a sample.

The practical uses of this device are innumerable. A fashion expert visiting Paris for an American dress manufacturer, for example, can cable the mathematical formula of the newest fashionable shades so that they can be reproduced precisely without delay. To the man whose wife asks him to go to the store and match a piece of silk or a pair of stockings it should prove an inestimable boon. No longer will he have to try to discover what the shopkeeper means by such vague terms as "ecru," "mauve," "elephant's breath" or "moonlight," actual names given to colors.

Farms in the Sahara?

RECLAMATION of the Sahara Desert, long discussed, is now receiving attention as a serious project by the French government. Dwight Braman, of Boston, Mass., an irrigation engineer, has worked out the plan for letting in the Mediterranean through canals and damming the rivers which flow down from the Atlas Mountains. This would create a great inland sea covering 90,000 square miles. The moisture from evaporation would change the climate for hundreds of miles in all directions, possibly affecting that of southern Europe as well. The soil is rich and, with water available, would be highly productive.

This project, if carried out, might change the whole course of international trade and put North Africa back on the map as a center of civilization.

New Material for Airship Bags

THE U. S. Bureau of Standards announces that its technicians have developed a substitute for goldbeaters' skin for use in the manufacture of the gas cells which, inflated with hydrogen or helium, lift an airship.

Goldbeaters' skin is an expensive product. It is pre-



Necklace 35,000 Years Old

Henry Field, Assistant Curator of Physical Anthropology, Field Museum, Chicago, is now here examining a necklace believed to be 35,000 years old. Found in a cave in southwestern France. It contains 150 beads carved, it is thought, from the tusks of mammoths.

pared from the intestinal membrane of the ox, and derives its name from its use in the final process of manufacturing gold leaf. Sheets of gold are reduced by previous beating to such thinness that 930 of them, piled alternately with squares of the skin, measure only three quarters of an inch in thickness. This pile, or "mold," is then beaten for four hours with a seven-pound hammer until each sheet of gold leaf is only 1,150,000 of an inch thick.

The thinness, toughness, and imperviousness of the goldbeaters' skin has made it heretofore the only substance light and tight enough for airship gas cells. Each skin measures five inches square, and it took 500,000 of them to make the gas cells for the dirigible *Los Angeles*.

Commenting on that fact, an Irish newspaper recently gravely informed its readers that the little animal known as the goldbeater, a native of North America, which derives its name from its habit of beating or stamping upon the ground in the vicinity of the gold mines of the Far West, was in danger of extinction, so many were being killed for their skins to make airships!

Will the Ocean Overflow?

TO MOST of us Commander Byrd's Expedition to the Antarctic savors more of adventure than of science; but if his researches on the south polar ice cap answer but one question they may prove of the greatest value to the world.

That question is: Is the Antarctic ice cap melting?

If it is, then the seacoast cities of the world might better begin now to move inland, to high ground, for the complete melting of the Antarctic ice would release enough water, now stored as ice, to raise the level of the whole ocean by fifty feet, according to Sir Edgeworth David, of Sydney, Australia, a distinguished explorer and geologist.

There seems to be ground for belief that the tradition of a world-wide flood, persistent among all ancient peoples, may have originated in the rise of the oceans when the Arctic ice cap melted at the end of the last Ice Age, approximately twenty thousand years ago.

New Cancer Hope

CANCER is a disease for which no cure has been found. But the use of the knife in its early stages. One woman in eight and one man in fourteen dies of cancer. It occurs most frequently in people whose blood is alkaline. Dr. Charles Mayo, famous surgeon of Rochester,



New Machine to Fight Cancer

The newest aid in the early and final treatment of cancer is the machine invented by Charles Wey, of the University of Pennsylvania. It measures the alkaline balance of the blood in terms of voltage.

Detects Artificial Pearls

By photographing the heart of a pearl, the instrument at the right, invented by M. Reaulet, a French chemist, determines whether it is genuine. A small camera is focused on the gem through a powerful lens.



*Brief Bits of Fact and Interesting Comment from
the Month's Records of Discovery and Invention*

Minn., recently told the American Public Health Association that the tendency to cancer is hereditary. Cuban authorities are considering a proposal to permit scientists to experiment on condemned criminals with cancer inoculations, instead of putting them to death.

A treatment, less repugnant, may result from the use of a machine recently developed by Dr. Charles Weyl, of the University of Pennsylvania. This machine diagnoses the disease and directs its treatment by measuring the relative amounts of alkali and acid in the blood.

An Artificial Heart!

LIFE remains one of the unexplained phenomena of the universe. It seems improbable that scientists ever will be able to produce life from nonliving materials, but through an amazing series of laboratory experiments many things about life and death are being learned.

Recently the Moscow Scientific Institute reported that the head of a dog had been kept alive for three hours after it had been severed from the body. And in a glass jar at the Rockefeller Institute of Medical Research in New York there is part of a chicken's heart which the famous Dr. Alexis Carrel has kept alive for nearly twenty years.

The Moscow experiment, conducted by S. J. Brukjanenko and Dr. S. I. Chech, after the animal had been placed under an anesthetic, was accomplished by means of an artificial heart made of steel and rubber which pumped blood to the dog's head. The experimenters declared that the detached head swallowed food, although there was no stomach for it to go into, snarled and bared its teeth, and

responded to the slightest touch. Tests made with quinine and capsaicin indicated that it was capable of tasting.

In a similar experiment in Russia, a monkey which apparently had been dead for hours was resuscitated by the injection of its own blood, and at last report was alive and normal. Just what the future may bring from these experiments



The Tropics are a Hot

[illegible]

it is impossible to tell, but from such research physicians learned how to resuscitate patients, after the heart had stopped, by the injection of adrenalin.

No Fire in Redheads?

A SCIENTIFIC pronouncement which may start lively arguments comes from a report of the British Social Hygiene Council. This indicates a belief that redheads, instead of being natural fighters and bery adventurers, are really victims of an in-born inferiority complex.

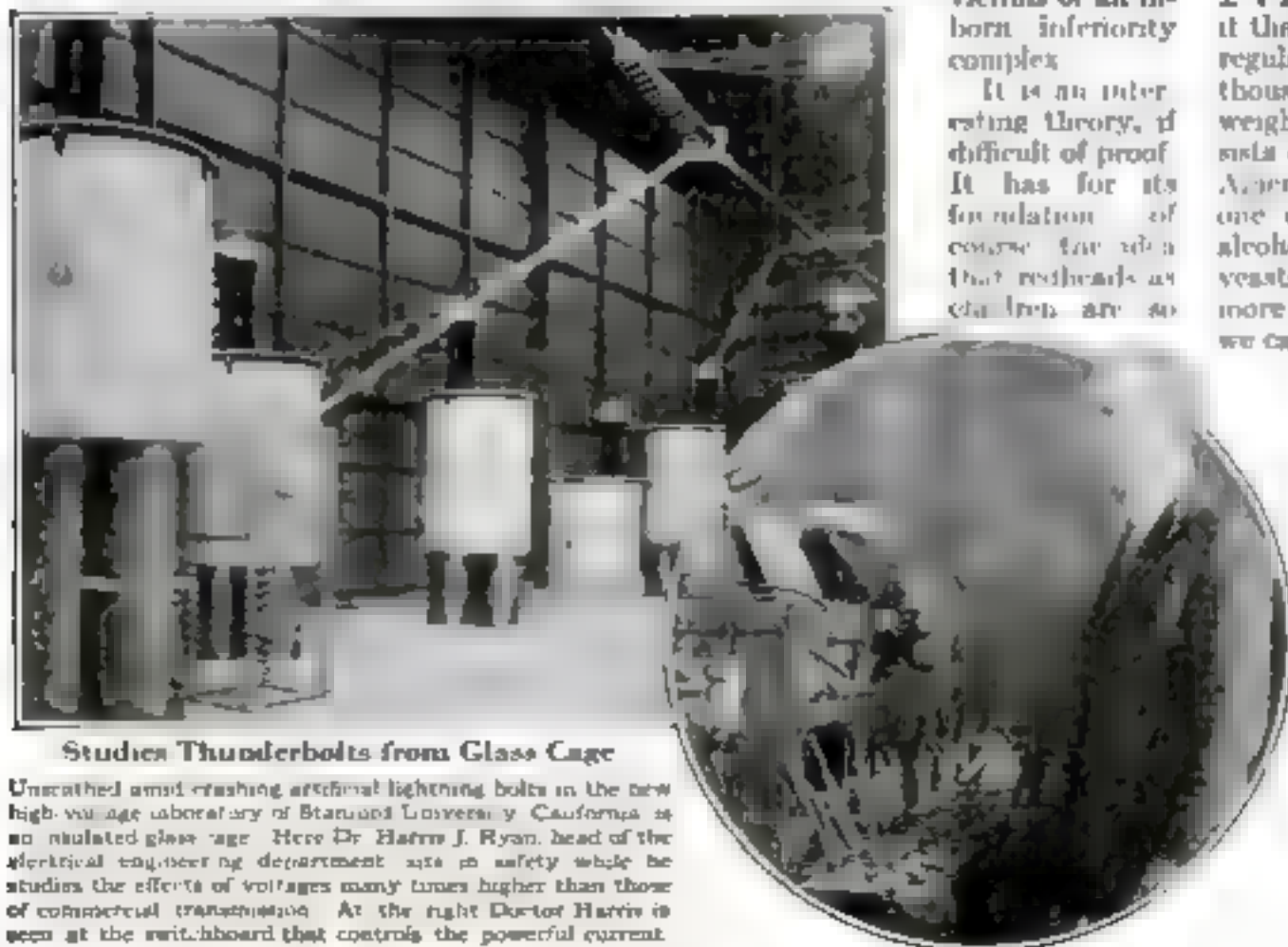
It is an interesting theory, if difficult of proof. It has for its foundation—of course for idea—that redheads and children are so

trained that they are forced into being vigorously on the offensive-defensive, until it becomes a habit. Schoolroom tests often have a lasting effect on the lives of people. It is related of Napoleon that he first determined to be a soldier when a schoolmate twitted him about his small stature, saying that there wasn't enough of him to make a soldier.

Every Man His Own Still

NATURE has slight regard for the Eighteenth Amendment, but sees to it that every human being has his or her regular daily supply of alcohol. Three thousandths of one percent of the total weight of the normal human body consists of alcohol, says the Journal of the American Medical Association. Each one of us is constantly manufacturing alcohol from the sugars, starches, and yeasts we eat as food, but it would take more than a hundred times as much as we can get in this way to produce intoxication.

To discover what goes on in the chemical laboratory of the human body is a quest upon which scientists are working more than on any other single problem. The mechanics of the body, considered as a machine, have long been well understood; its chemistry still holds fascinating mysteries. It may take a long time to uncover all of them, but we have plenty of time ahead of us. A billion years, at least, is the latest estimate of the future duration of the earth, according to Prof. R. A. Millikan, of the California



Studies Thunderbolts from Glass Cage

Unsheathed amid crashing artificial lightning bolts in the new high-voltage laboratory of Stanford University, California, is an insulated glass cage. Here Dr. Hiram J. Ryan, head of the electrical engineering department, sits in safety while he studies the effects of voltages many times higher than those of commercial transmission. At the right, Doctor Harris is seen at the switchboard that controls the powerful current.

Cathedral Blasted from Cliffs



Turning the rocks into a mighty edifice of waiting beauty. Right: A great block of granite blasted from the quarry. Left: The great block of granite being worked above the cathedral.

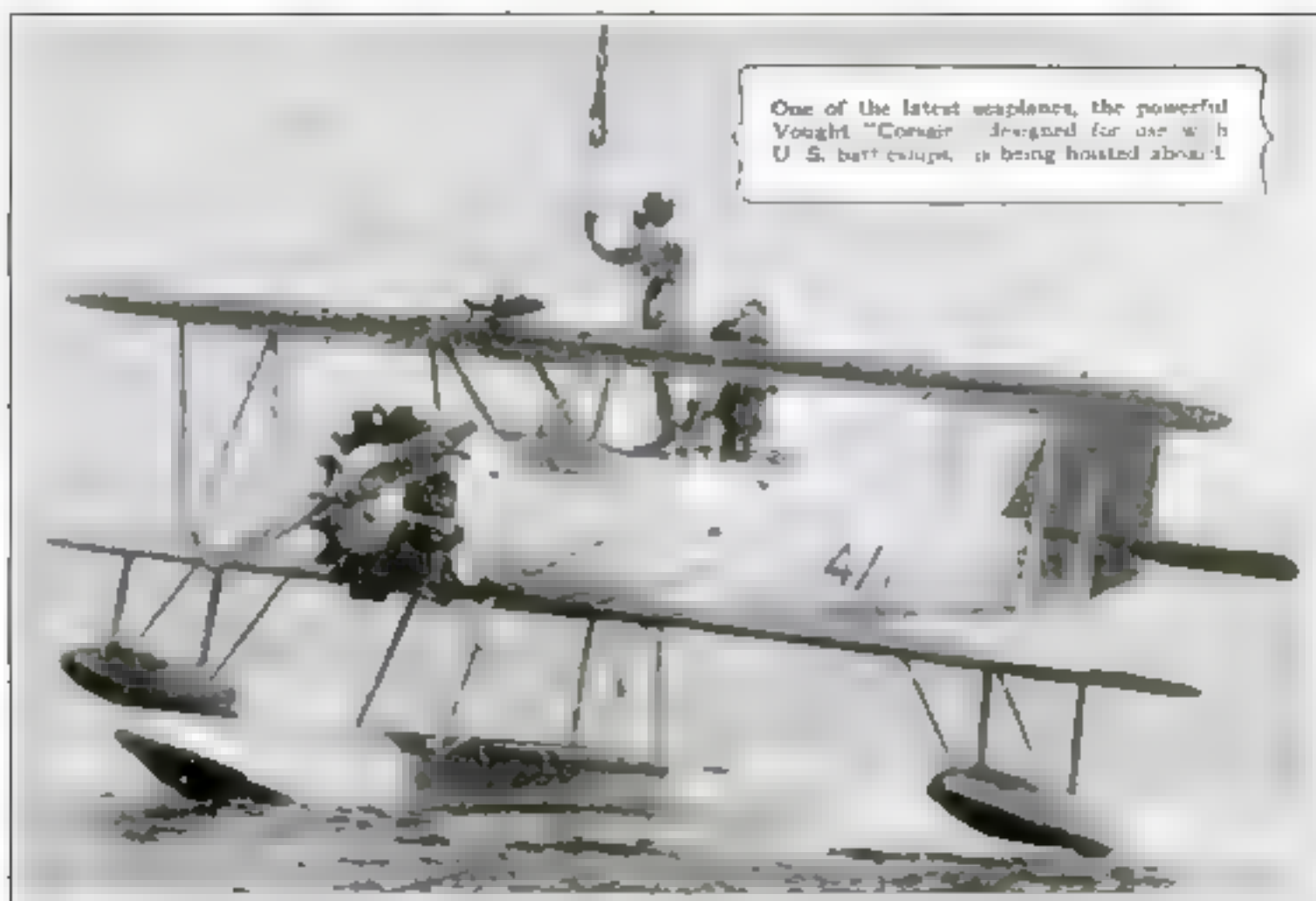


NEAR Peekskill, N. Y., the old Mohawk granite quarry, now worked for years, has been reopened to supply stone for the building of the great Cathedral of St. John the Evangelist on Mount St. Ignace Heights, New York City. And the skyscrapers of the metropolis, the cathedral will be among them that it will contain.



During the operation, water is poured over the block and stone to keep them cool and to prevent them from cracking.

When the slabs have been cut to the desired size, they are transported by motor track to the site of construction. Each piece is packed carefully to maintain the exact position it will occupy in the building. And that is necessary for the workmen to fit the pieces together and cement them in place.



New Marvels of Plane Design

Astonishing Secrets of Engineering Behind the Latest Triumphs of Speed, Power, and Reliability in Aircraft

3464/5
by ROBERT T. FORD

THE other day a Curtiss Army plane equipped with a Wright Whirlwind motor, sped over Langley Field, Va., at 137 miles an hour. That was a pretty good clip for this type of machine, though not unusual.

The unusual part of it was that the tachometer on the pilot's dashboard showed the propeller turning over at the rate of only 1,800 revolutions a minute. To an Army pilot, that is almost miraculous, because at this propeller speed the best such a plane ordinarily will do is 118 miles an hour.

Where did the extra speed come from? Over the nose of the machine, hiding most of the engine, was mounted a curious cowl that resembled a bottom-up bowl with the base knocked out. The hole allowed the propeller shaft to poke through.

Known as a "Venturi cowl," this device, just developed by the National Advisory Committee for Aeronautics, slashes the normal drag on a plane of the air whistling past an air-cooled engine. By making the air stream pass in a smooth stream around the fuselage, it adds more than

IN CALIFORNIA, recently, a 2,000-pound plane took the air with a cargo weighing more than two and a half times as much as the plane itself. It was the greatest load ever carried by a heavier-than-air machine.

In this absorbing article, inside facts and secrets of engineering that have made possible the marvelous speed, strength, and lightness of modern flying machines are revealed by a veteran Army aviator.



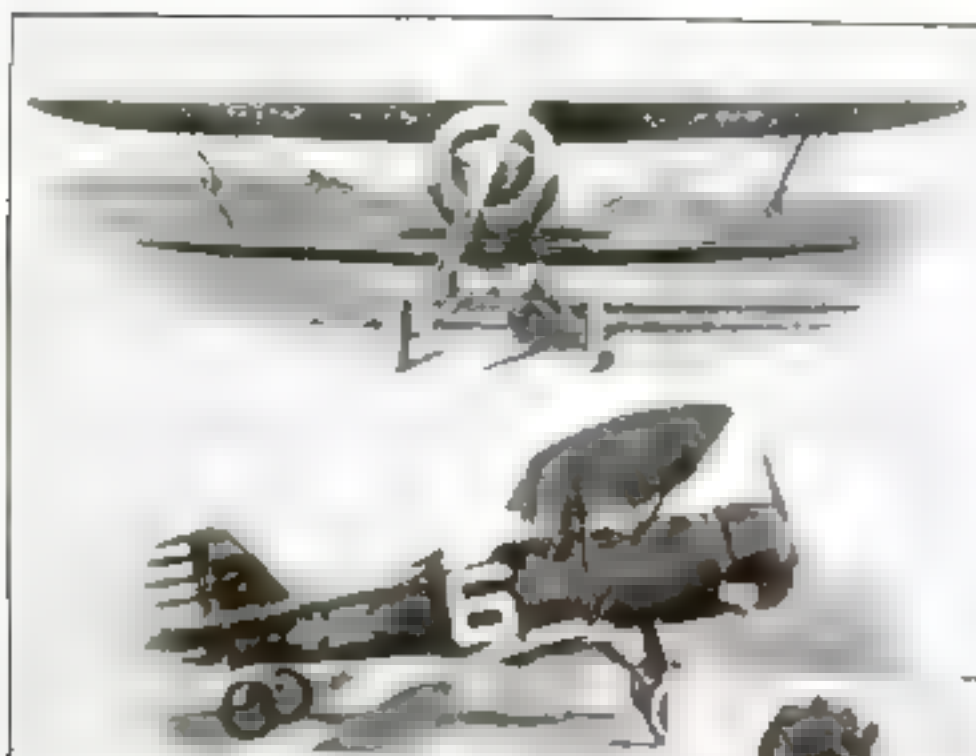
How new plane models are tested. Recording instruments give experts in New York University aeronautical laboratory results of wind tunnel test.

thirty percent to the effective horsepower of an air-cooled plane in flight.

Military experts hail the invention as the most valuable single contribution to airplane efficiency since the war. It is an example of efforts to improve the whole design of airplanes—efforts beset with difficulties of which the average man never dreams.

Imagine designing an airplane light enough to carry a heavy "pay load" in addition to its own weight—strong enough for safety—frail enough for a featherweight color to drag through the air—and well-shaped enough to offer the least possible resistance to forward motion. Add to that, too, the fact that it must be easy to control and economical to run. The wonder is not that we fly across oceans, but that we can fly at all.

Strength and lightness—the two are inseparably bound together, as every airplane maker knows. It's easy, for instance, to make a wing brace that is strong. It's easy to make one that is light. But when you try to combine the two, what you have is a piano-wire brace so delicate that it must be scrapped if bent, in shipping, by so much as forty-five degrees from a



Curtiss AT-3 Army plane fitted with new Venturi cowling which, by reducing wind resistance, increases plane's speed nineteen miles an hour.

straight line. Otherwise a pilot, some bumpy day in the air, is likely to be in for a rough time.

Every hundred pounds of added weight, in a plane, means three more horsepower to pull it. It has taken years to bring commercial planes to the point where they can carry one pound of pay load—that is, lifting power besides the weight of pilot, oil, and fuel—for every three of total weight. That pay load means dollars and cents to the commercial flyer. And the fact that even now two pounds ride deadhead for every pound that is carried explains in a nutshell the high cost of commercial flying.



Why planes use gasoline power plants. The best gasoline motors (left) weigh only a pound and a half to the horsepower; steam turbines (center) six to eight pounds; electrically-driven motors (right) seven and a half pounds.

Only within the last year or two have new instruments been designed in making the weight-versus-strength compromise. They eliminate guesswork as to what particular parts of a plane need to be strongest. By photographing the rise of liquids in small tubes, or the movement of beams of light from the sun or lamps on photographic paper, these instruments record pressures and strains in various parts of a plane in flight. By such measurements it was discovered not long ago that loads on a certain wing part were twice what manufacturers had been allowing for. Small changes in tail structure suggested by them have improved certain planes difficult to control at critical speeds. They also cured a certain plane's habit of going into a flat spin.

During the war the writer wondered why he had to wind so many

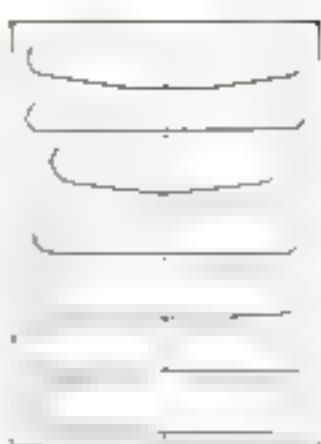


Small model of world's largest flying boat, by E. P. Burton, California aircraft designer.

rubber shock absorbers to replace broken ones on machines used to train cadets. The pressure-detect-



A striking departure from the usual airplane design—the Fairchild amphibian monoplane, with wings that fold back when the plane is to be stored in its hangar. This was the first ship to reach the stranded Seavon at Greenly Island.



An example of the diversity of modern airplane construction. Here are some typical wing shapes of the 1929 airplanes.

one-ton plane, stalling six feet above the earth, but the shock-absorbers with a blow of four and a half tons! After that discovery student pilots were ordered to level off a foot above ground before landing.

Search continues for lighter but strong materials. Weight for weight, wood is as strong as the strongest steel. Birch is cheaper to use than metal when one wishes only a single propeller. Lighter metals, aluminum alloys like duralumin for instance, are coming into wider use as a result of greater technical knowledge. The Ford air liners are covered with duralumin fourteen thousandths of an inch thick.

Many parts of an airplane could be made lighter than they are now, if the machine were to be flown only by capable men. The material, though, would snap like matchsticks under careless handling. And the designer, knowing that some clodhopper may clamber over fragile parts, adds a pound for safety and thereby drags more power from an already burdened engine. In ordinary engineering terms, a "factor of safety" means that a structure is strong enough to sustain a certain number of times, say six times, its maximum load. In a plane, a factor of safety of six means that it will stand six times its normal load, a very different thing. In spite of this necessarily close margin—for under certain conditions such as a steep dive a plane may practically wipe out its factor of safety—structural parts almost



Testing a forty-inch scale model of a transoceanic seaplane in wind tunnel, to determine air worthiness of design.

never break in flight except through stunting or careless handling.

If the load can be scattered along the wings instead of all concentrated in the body, then the structure can be made lighter. One designer moves two motors out on the wings. Ten other designers follow. Then another thinks of splitting the body in halves lengthwise, with a motor in front of each half. Still another offers a plan that calls for practically no (Continued on page 134)

When the Sky Rains Soldiers!

THE next war, if any, may be fought with parachute battalions of armed soldiers dropped from the air. They may play a decisive part in tomorrow's battle.

Some of the latest developments in aviation for a career pilot's jump are over the clouds. For instance, a British pilot has jumped from a plane and landed safely in a net of balloons. This was a first for a man. The net was made of balloons and was suspended by a rope. The pilot was able to land safely and was not injured.

Other experiments in parachute jumping are being made. At a recent air show, a pilot jumped from a plane and landed safely in a net of balloons. This was a first for a man. The net was made of balloons and was suspended by a rope. The pilot was able to land safely and was not injured.

At the same time, a pilot jumped from a plane and landed safely in a net of balloons. This was a first for a man. The net was made of balloons and was suspended by a rope. The pilot was able to land safely and was not injured.

A parachute battle scene of the future based on the use of balloons. The pilot is shown in a net of balloons, suspended by a rope. The net is made of balloons and is suspended by a rope. The pilot is able to land safely and was not injured.



Swimming Turtle Is "Hour Hand" of Novel Clock

ATURTLE tells you the time in a unique timepiece produced in Switzerland. At first glance, the clock appears to be a sundial with a circular tray, filled with water, set in the face. In this tray a small imitation turtle floats, carrying a piece of steel in its beak. As the hour hand advances under the tray it attracts the turtle by means of magnets.

If removed from the water and later replaced, the little turtle immediately swims across to the point on the tray directly above the hand, thus indicating the time.

The eight-day-clock mechanism is wound in the usual way, and regulated after the tray and the face of the timepiece are removed.

According to the importers, who recently brought the novel timekeeper to America, the beautiful marble base in which the clock is set makes the instrument suitable for display upon a pedestal or table center, serving as an ornament as well as a dependable timepiece.



Floating in the tray the little turtle moves around the dial like the hour hand of a clock.

How Much Do You Know About Astronomy?

HERE are ten questions selected from hundreds asked by our readers. See how many of them you can answer. Correct answers are on page 188. You'll find this an entertaining way to test your knowledge in one of the most fascinating fields of science.

1. What are the shooting stars?
2. Of what substances are the sun and the stars composed?
3. How do astronomers know the distance to the moon, the sun, and the stars?
4. What is a comet?
5. Are the moon, the planets, or the stars inhabited?
6. Why does the eclipse of the sun by the moon completely blot out the sun only in a narrow path?
7. What is the ring around Saturn?
8. What is beyond the stars?
9. Why can't we see the stars in the daytime?
10. Why do stars twinkle?



Air Propeller Drives Passenger Catamaran

WITH its twin hulls sinking only nine inches into the water, a unique air-driven catamaran carried nine passengers and attained a speed of nine miles an hour with full load when put through its paces recently at Dudley, England, by its inventor, W. F. Davies.

The two skull-like hulls are driven forward by an airplane "pusher" propeller span at the rear of the boat by a four-cylinder, water-cooled motor. The operator, steering the vessel with a wheel, sits behind the passengers in the streamlined body, near the motor. Doors, similar to those in an automobile, enable the passengers to enter and leave the body of the boat easily. Straps fastened to the top of the hulls prevent accidents to passengers through slipping.

Rocky Mountain Wilds Are Reserved for Science

SEVERAL million acres, comprising forty-two separate tracts in the Rocky Mountain Forest District, have been set aside by the U. S. Department of Agriculture as "wilderness areas" to be used for science and recreation.

Thirteen small areas in the national forests of Colorado, Wyoming, and South Dakota have been set aside for scientific observation and research, and all commercial and recreational activity in that territory is prohibited. A 100,000-acre wild, inaccessible area on the Washakie National Forest in Wyoming is closed to commercial use and open for recreation. The remaining twenty-eight areas, including 2,451,030 acres in Colorado, Wyoming, South Dakota, and Minnesota, will be kept in a wild state.

"Busy Bee" a Myth—He's a Loafer, Tests Show

DR. LLOYD R. WATSON, of Cornell University, a scientist who apparently doesn't care what happens to our pet illusions, has just announced the results of fifteen years of research work among the bees, which showed him that these insects, accepted as symbols of industry, are really work-shirkers.

The professor, who has been making bees "punch a time clock," has discovered that, instead of toiling from morning till night, as generally believed, they make from six to ten trips in quest of honey and loaf the remainder of the day. Meanwhile, he has tried to develop a really busy breed of bees, and as a result of these experiments the number of varieties which have actually profitable characteristics has been reduced to four.

Human Body's Electricity Reported Photographed

IN RESEARCH work tending to show that the human nervous system is an intricate electrical network with the brain as its semiautomatic switchboard, two scientists in Munich, Germany, claim to have photographed electric current issuing from a man's body.

The current waves are said to have been amplified to a point at which pictures could be taken. The photos, it is reported, showed sparks radiating from the fingers of an outstretched hand.

If the skin is dry, the experimenters declare even the slightest motion of the fingers will produce sparks that can be "snapped." The pictures further showed that the oscillations increase when the fist is closed and opened quickly.

Weak Feet Walk on Air in New Arch Support

WALKING on air is more than a figure of speech for users of a new arch support which is pumped up with a small hand pump. The air cushion, attached to a thin inner sole, is made of a rubber composition said to possess great strength.

One of the supports is reported to have withstood a pressure equivalent to the weight of twelve heavy men. The chief advantage claimed for the invention over the ordinary metal support is increased comfort and "springiness" in walking.



Inserting pneumatic arch supporter attached to inner sole. The air cushion is pumped up.

Opals, Once Feared, Today Yield Vast Fortunes

ALTHOUGH a popular superstition persists to the effect that opals are harbingers of death and sorrow, Australia, the chief source of the world's supply of these gems, derives revenue estimated at millions of dollars from them. An opal valued at \$5,000 was found recently near Walgett, New South Wales.

Australia, too, enjoys the distinction of being the only country to produce the much-admired black opal. One specimen of this stone, weighing six and a half carats, was found in 1910 and sold for \$350. In 1920, another specimen brought \$3,000. The black opals are the product of Wallangulla Field, New South Wales.

Since 1890, the total value of opals won in Australia has been estimated at \$7,750,000, and this figure does not include the prices realized for some very fine pieces found and sold privately. In various parts of New South Wales some 12,000 acres of opal-bearing country remain unprospected.

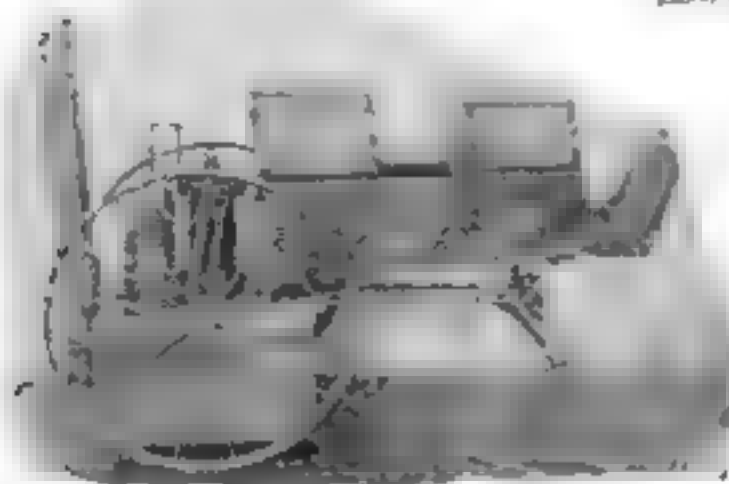
Enjoying general favor among the Greeks and Romans of antiquity, the opal fell into disrepute in the Middle Ages, when it was believed responsible for the Black Plague, of which people died by the millions. It is from that time that the superstition regarding the opal as a bringer of unhappiness dates.

Queen Victoria, determined to popularize the gem product of her colonies, overcame much of the prejudice by presenting opals as wedding gifts to each of her daughters.

Steam-Puffing Granddaddy of Modern Auto Found

DUST-COVERED and with the paint peeled from its ancient body, what is thought to be one of the earliest ancestors of the 23,000,000 motor vehicles now in the United States was uncovered recently in an unused portion of a laboratory at the University of Maryland.

This early "horseless carriage," using steam as a source of power, is said to be the invention of the late Dr. William E. A. Aiken. Dr. Aiken was professor of chemistry at the university from 1888 to 1888. His machine—with the smokestack placed conveniently at the rear—was built long before the automobile era was ushered into America on April 19, 1892, by the success of the gasoline automobile invented and piloted by C. A. Duryea.



The queer steam "horseless carriage" unearthed, after nearly half a century, from a university laboratory in Maryland



Latest Ice Cream Cone Wears a Bonnet

ICE cream cones that wear caps, invented by C. K. Gummerson, of Pittsburgh, Pa., are said to keep the ice cream in shape from five to ten minutes longer than in ordinary cones and to protect it from dirt and street dust.

The cap also may be used separately as an ice cream container. A flat baked cake wafer is supplied as a lid to protect the contents of this small ice cream "plate." The cap, which is made of the same material as the cone, can also be eaten.

Life Span 100 Years by 1950? Experts Differ

CENTENARIANS may be the rule instead of the exception in 1950, according to Arthur D. Rees, formerly of the University of Pennsylvania faculty, who sees no reason why a 100-year average life span should not be the usual thing. Increased knowledge of disease and dietetics will shortly extend old age far beyond the Biblical "three score and ten," he believes.

A life of 100 years without a day of sickness is prophesied by Dr. George Walker, of the Johns Hopkins medical faculty. Long life, he says, is not a matter of luck, but of correct eating.

Less optimistic is Dr. Louis I. Dublin, statistician of the Metropolitan Life Insurance Co., who states that we have made little advance in lengthening life in the last eighty years. More people are living to old age, he says, but this is because we are saving more lives at younger ages, not that we have lengthened life. And Dr. Alfred E. Cohn, biologist of the Medical Research Department of the Rockefeller Institute, asserts that old age is a natural process, and medicine only has made it more comfortable.

Soldering Jobs Simplified by Electric Furnace

ONLY eight inches long and six inches wide, a portable electric furnace has been devised for heating soldering irons for small jobs. The temperature of the heating chamber is said to rise quickly to more than 900 degrees F., but an automatic control prevents it from mounting high enough to burn the point of the soldering copper. As further protection, the temperature where the soldering point rests is kept lower than at the center.

The furnace is designed to operate with any 110-volt electric light or power circuit and to consume current at a rate not greater than that of three 150-watt lamps. The device weighs ten pounds and is carried by means of a handle.



Portable electric furnace in foreground heats the crane for a small soldering job on a motor.

Know Your Car

HARD starting is a winter motoring trouble that is avoidable. Cold weather affects the functioning of the car's mechanism in several ways, and all of these are cumulative in causing hard starting.

Much more current is consumed by the starter motor to start a very cold engine, due to the friction of the congealed oil. The short period of daylight causes you to use the lights more than in summer. In addition, you probably do not take any long rides in cold weather. The result is that more current is drawn from the storage battery than is put back by the charging generator. Consequently the voltage is low and the spark correspondingly weak just at the time when a hot spark is most needed to ignite the chilled and only partly vaporized mixture.

An extra charge for twelve hours at a time with a full rate radio battery charger will help to eliminate hard starting. Once every two weeks is sufficient.



Searchlights on Wheels Aid Fire Fighters

FLOODLIGHTING has become a part of fire fighting in Chicago. A new "light wagon" recently added to the equipment of the city's fire department will respond to all important calls, furnishing light by which the firemen can work more effectively. Mounted on the top of the truck are a number of large searchlights which can be directed at any angle upon a burning building. Within the truck a large gasoline motor runs the dynamo which generates the electricity used in the lighting, making the apparatus an independent unit in itself.

It is believed that this arrangement by which "all fires will be fought in the daytime" will prevent accidents caused by men stepping into holes in the dark or at mauling over unseen objects. It will also enable fire officials to judge more accurately when burning walls and timber will fall, giving them time to protect their men from such danger.

English Hard for Parrots

PARROTS, tested at the municipal zoo in Dallas, Texas, demonstrated that they could learn Spanish easier than either English or German. One parrot speaks Spanish words picked up from countless Mexican visitors and has never spoken a word in English. In El Paso a parrot learned Spanish and Chinese, but seldom spoke English.



Remarkable photograph showing giant torpedo an instant after it was shot from the deck of a new destroyer built for the Chilean Navy.

Radio Pictures Made Lifelike

TELEVISION pictures which give the impression of depth as well as width are said to have been produced by John L. Baird, pioneer Scotch television experimenter, by using a stereoscopic receiving set. Behind the spinning disk, with its spiral perforations, two pictures appear simultaneously. When seen through two prismatic lenses, the two images seem to combine and give the impression of a solid object.

In the United States, an official designation for the area of a single picture in television was announced recently by the Radio Manufacturers' Association. The word "frame" will be used, as in moving pictures. Each frame is to be scanned in forty-eight lines. The scanning will proceed from top to bottom and from left to right. Fifteen separate frames or complete picture area scanings a second will be the standard speed of showing. This decision was reached in an effort to standardize television equipment.

Cameraman Snaps Torpedo Diving into Waves

LIKE a succession of huge flying fish skimming over the water and dropping into the waves, a series of torpedoes sped from the deck of one of the latest destroyers during recent tests in the English Channel. A photographer aboard the warship snapped one of the giant missiles as it plunged through the air, obtaining the remarkable photograph that is reproduced below.

The vessel is one of several destroyers constructed by a British shipbuilding concern for the navy of Chile. The rapid-fire discharge of practice torpedoes formed one of the concluding tests through which the war vessel was put before its acceptance by the Chilean government.



Apparatus for receiving television pictures in stereoscopic relief being demonstrated by its inventor (standing at right)

Gypsum Increases Soil's Capacity for Moisture

MAKING land thirsty in the work of a new apparatus developed by the U. S. Department of Agriculture. In the western states some irrigated fields, known as hard spots, or hard land, do not absorb water readily. Experiments have shown that irrigation water containing more sodium than calcium increases the hardness of such soil. In other words, "soft water makes hard land and hard water makes soft land." Gypsum, dissolved in the irrigation ditches, increased the ability of such spots to absorb water. So experts of the Department devised an automatic apparatus for adding gypsum to irrigation water.

Tribesmen Jail Idols If Prayers Are Unanswered

WHEN their prayers are not granted, Mexican tribesmen bind their religious images with ropes and leave these fetters on until the desired happening occurs or their displeasure abates, according to Edward A. Westermarck, noted English sociologist, who has just concluded a study of their ceremonies.

A similar instance is reported to have occurred in China in 1888. The mandarins of Canton prayed to a god to stop an incessant downpour of rain. When he turned a deaf ear to their pleas, they put the idol in jail. When the rain ceased, they returned it to the temple.

Masks Safeguard Health of Paint Spray Users

AT LEAST nine tenths of the lead in air containing paint mist is removed by the use of respirators with cotton, paper, or fabric filters, Surgeon General H. S. Cummings announces as the result of experiments by the Public Health Service, in Washington, D.C. The addition of a canister of activated charcoal eliminates most of the solvent vapors as well. These canisters of charcoal may last for weeks, the report states, before the contents become saturated and useless. The experiments were carried on under conditions considered extreme, high percentages of paint being in the air.



A bird's-eye view of the gigantic new highway across the James River. It cost \$7,300,000.

Begin Search for Diamond Fields in Canada

ARE there diamond fields in Canada? Not long ago, some diamonds of commercial size were found in Indiana by tourists who examined debris around the rock mounds left in parts of that state at the end of ancient glacier drifts. Discovery of this treasure has revived interest among scientists in the possibility that there may be diamond-bearing rock in the James Bay region in Canada.

The Indiana diamonds are by no means the first to be found in the United States. Diamonds have been encountered in Georgia, Kentucky, Virginia, Tennessee, Wisconsin, California, and Oregon. A crystal weighing twenty-three and three-fourths carats was found in Virginia in 1853, and one weighing twenty-one and one-fourth carats in Wisconsin in 1886. A number of small diamonds were unearthed near Murfreesboro, Pike County, Arkansas, in 1900.

News of the recent Indiana find has resulted in exploration in Northern Ontario, but although some small crystals found there have been pronounced diamonds by Dominion mineralogists, their identification has not thoroughly convinced diamond experts. Even if the stones are diamonds, they are said to be so small as to possess little commercial value.

Big Trees, Centuries Old, Found to Be Fireproof

ONE of the reasons for the amazingly long life of the California Big Tree, the forest giant which reaches an age of 4,000 and sometimes even 6,000 years, was discovered a few weeks ago. Experiments with its bark showed that it has a resistance to fire surpassed only by that of asbestos! Consequently, the great tree survives the forest conflagrations which destroy its more inflammable brethren.

A piece of the bark twelve inches square was put in a wood fire in a lumber mill furnace and burned for eight hours. At the end of the test, the bark was no more than charred on the outside.

Five-Mile Highway Built Across James River

THE world's longest highway bridge, a five-and-a-half-mile span crossing the James River in Virginia, and connecting Newport News, Norfolk, and Portsmouth, was opened to traffic recently.

Built at a cost of \$7,000,000, the new bridge closes a large gap in the Atlantic Coastal highway and forms a direct road down the historic Virginia Peninsula.

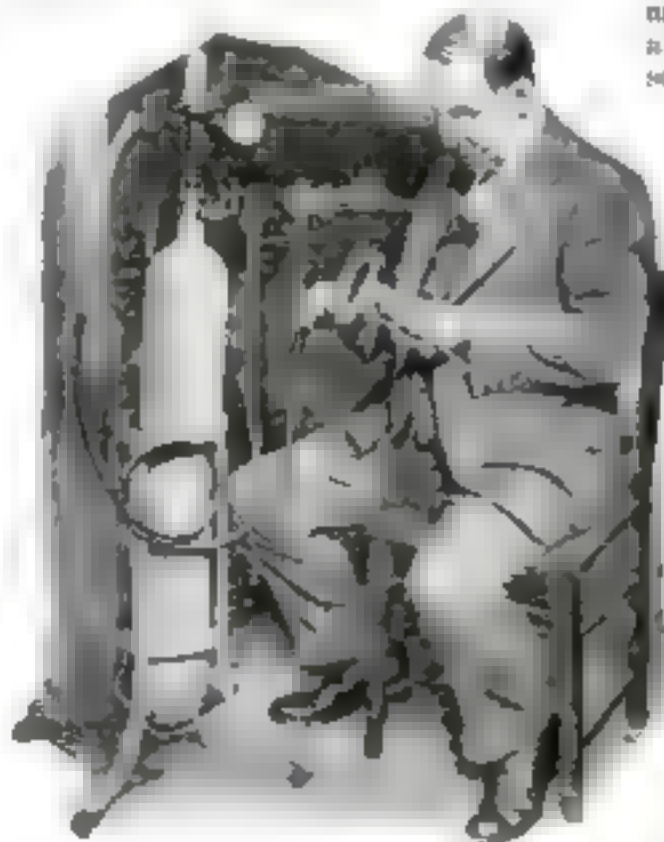
The huge span rests on piles which, in many cases, descend 100 feet under the surface of the water. In one spot, the bridge rises to a height of 300 feet above the river, but most of the twenty-three-foot roadway is fifty feet above the water level. The great structure has one of the largest lift-spans in existence, three hundred feet long with a lift of fifty feet, allowing space for even the largest vessels to pass through.

The James River Bridge is the only one downstream from Richmond, which is seventy-three miles from Newport News. Together with the two older bridges across Chuckatuck Creek and the Nansemond River, it completes a long-needed link between the Virginia Peninsula and the mainland.

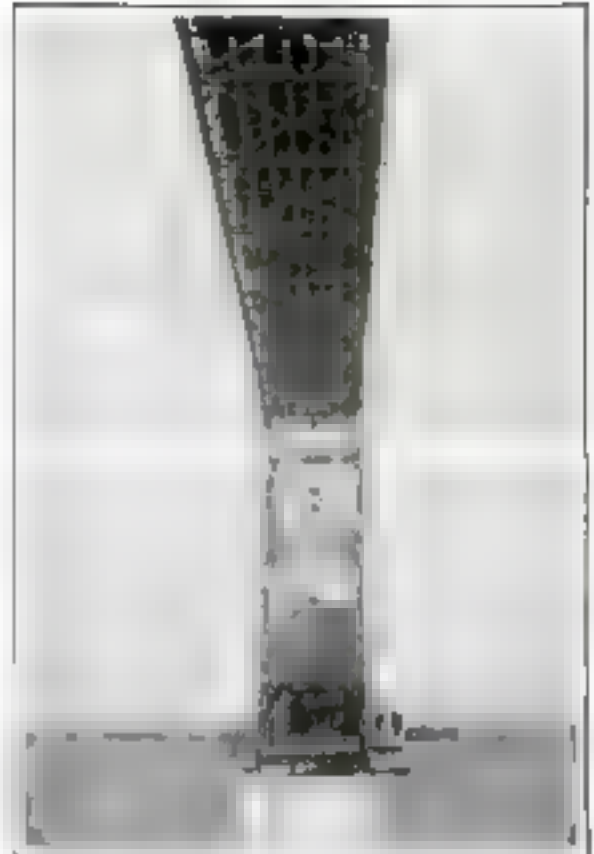
Compressed Air Drill New Aid to Surgeons

THE pneumatic drill, familiar to engineering, is the newest of aids to surgeons in the operating room. Dr. W. H. Ogilvie, an assistant surgeon at Guy's Hospital, London, England, is the inventor of the new surgical instrument, pictured below. It is designed for use in difficult bone operations and is constructed on the same principle as the compressed-air drills used in steel construction.

The miniature drill is connected with a cylinder of compressed air, which is carried in a holder that rolls on casters. Thus it can be transported readily from room to room. The drill is controlled by a trigger on the "gun grip" handle by which the surgeon holds it.



Pneumatic drill for surgeons' use in bone operations. It is driven from the compressed air cylinder at left.



The huge lift span, 300 feet long, raised to a height of 300 feet above the river surface.

Your Busy Heart Is Fed by Tiny "Dinner Pails"

THE adult heart—the only organ in the body whose muscles never rest nor sleep during life—makes an average total of 108,000 beats every twenty-four hours! How does this busy organ find time to "eat" and fortify itself for its arduous labors?

It remained for a Japanese scientist, Professor Y. Kato, of the Okayama Medical College, to solve this interesting mystery. Kato, after a long period of investigation, announced the other day that he had discovered that Nature has provided what may be described as little "dinner pails" from which the muscle fibers of the heart—which, indeed, has scarcely time to "eat"—are ingeniously "fed."

He studied small fragments of heart muscle under the microscope and found tiny disk-shaped organs between the muscle fibers. He injected chemical reagents into the blood of animals and, after examining their heart muscles, observed that these substances had accumulated in the little disks.

On these and other facts the Japanese scientist bases his theory that the disks are, in effect, dinner pails, which collect food materials from the blood and pass them around to the heart muscles.

Plan World's Largest Airplane Plant

THE largest aircraft manufacturing plant in the world is soon to be built in California, according to a recent announcement by interests that have purchased control of the Fokker Aircraft Corporation. Anthony H. G. Fokker, creator of the ships that bear his name, remains in charge of design.

Airplanes of all types will be produced in enormous quantities. Already the Fokker plants here and abroad have manufactured 16,000 planes.



At left: The "softball" tennis device installed on a roof of a building. If the ball is missed it is not lost for it is fastened to the stretched rubber band between the two poles by a rubber band which snaps it back to the player when it

Below: This man is using the new tennis device on a roof of a building. The device is a

Rubber Band Returns Ball In One-Man Tennis

YOU can play tennis with yourself by means of a simple one-man tennis outfit recently introduced into this country. Striking lobbed or speedy backhand strokes is no longer a feat of your own back yard with a pair of smashing windows or losing balls, the makers of the device point out.

A long rubber band with a tennis ball attached to the end is fastened to the center of a thin fiber rope stretched between two tall poles. The ball is put in service in the usual way, and the rubber band speedily returns it each time it is struck. Skill is required to drive the ball at the correct angle to make it return directly to the player at the right height for another drive. Amateur and professional players who have used the device say that it gives valuable training in controlling the direction of strokes and also in timing them properly.

How the apparatus may be set up on the roof of an office building or hotel is illustrated by the photograph above, in which Wallace Bates, a former tennis champion, and a friend are shown trying out the new device.



Chemical Makes Open-Air Ice Skating July Sport

ICE skating in a bathing suit under a cooling summer sun has been made possible by the recent discovery, in Germany, of a chemical substitute for ice. When spreaded over a smooth floor, the chemical immediately hardens to a solid polished surface over which the sharp runners of the skates glide without cutting through. This artificial ice will stand high temperatures and can be used in door rinks even in the middle of July. Its expense is negligible compared to the upkeep of a skating rink using real ice.

Air Landmarks Should Be Yellow, White, Black

CHROME yellow, white, and dead black are the three best colors for markings to guide aviators, such as towers of transmission lines along airway and field boundary markers, according to Woody Hockaday, Aeronautics Division, U. S. Department of Commerce. When these three tints are used in combination to paint stripes upon landmarks, it is explained, the white and yellow reflect the light and the dead black provides a contrasting background to give high visibility. Beacon sites on Federal airways are fifty-six foot chrome yellow arrows made of concrete.

Traveling Shears Clear Phone Lines of Litter

CLEARING telephone and telegraph wires of kites and other entanglements has been made easier by the invention of Albert Highower, a Fresno, Calif., mechanic. The mechanism consists of a trolley truck carrying a pair of strong shears operated by a rope and so designed that it cannot jump the wire since it is properly mounted. The shears will cut through rope and cloth and will even sever small limbs of trees which sometimes fall across the lines.

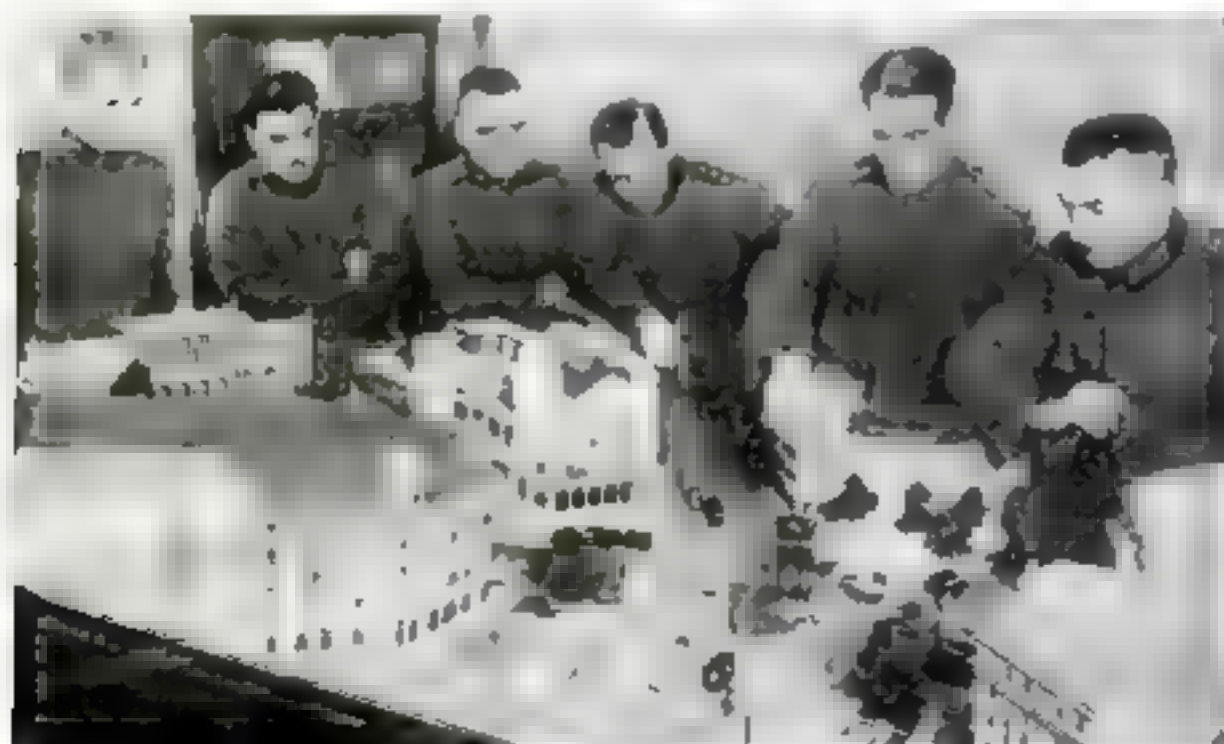


Shears, slid along the telephone wires on a trolley, cut away rope and other entanglements.

Traffic Problems Revealed by Working Models

TOYS are now being used to teach traffic cops of Berlin, Germany, to do their work more efficiently. Tiny horses and wagons, automobiles, and street cars move along the streets of a miniature model town, part of which is shown in the photograph at the left, while the policemen, under the direction of an expert traffic officer, determine how the little control station at the street intersection should be operated to control the traffic meeting from five separate streets.

Miniature wooden policemen, with their arms indicating "stop" or "go," are placed near the control tower to help give directions. A map on the wall behind the table gives a bird's-eye view of the thoroughfares of Berlin. Realistic touches are added to the street corner scene in the model—which, by the way, represents the famous Potsdamer-Platz—by the addition of little trees, lamp-posts, and pedestrians.

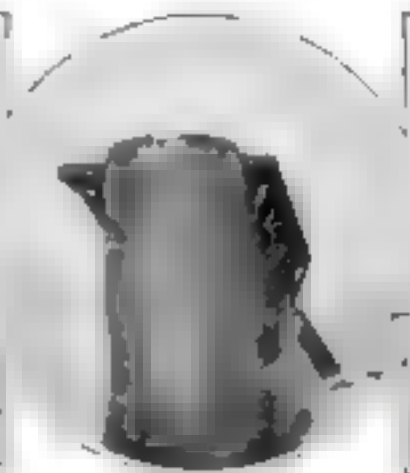


A miniature model of the Potsdamer-Platz, Berlin, with tiny automobiles and street cars, is used to teach German policemen methods of controlling the traffic at this and other congested points.

Self-Dumping Scow Turns Somersault in the Water



The start of the flip-flop. The loaded scow begins to sink on one side, as the underwater flood tank fills with water.



Over the goal. The emptied scow is in the somersault.



The scow bottom side up. The water ballast is seen pouring from the flood tank, and the deck is ready for a new load.

A SELF-DUMPING scow that flops over on its back and receives its next load upside-down, is being operated in the Puget Sound by a Seattle, Wash., company. Both the top and the bottom of the scow are identical, so it can be loaded whichever surface is on top. The unusual boat is 100 feet long, thirty-six feet wide,

and eleven and one half feet deep. Braced "sideboards," four feet high, keep the load in place while it is being towed.

The scow, built of wood, is divided lengthwise internally into two halves, each half containing an air-tight compartment and a flood tank operated through two eight-inch valves. On one side the

air-tight compartment is placed above the flood tank, and on the other, below it. A trip rope from the towing tug opens the flood valves on the side in which the flood tank is below the air-tight compartment. As this tank fills with water, the greatly increased weight on that side throws the load out of balance and causes the scow to turn completely over. The air-tight compartment, now being on the bottom, raises the flood tank above the water line so that the water drains out as the scow is towed back to its loading berth.

A 500-cubic-yard load can be carried by the boat and dumped in this manner.

Grafts Part of Human Eye in Amazing Operation

WHEN, in 1908, Dr. Hugh Mackay Dawbarn, the famous American surgeon, saved his son's life by grafting a large piece of his own skin onto that of the boy's, the operation astonished surgeons and physicians as well as laymen throughout the world.

Since then, many wonderful grafting operations have been performed, but it was left for a surgeon in the New York Eye and Ear Hospital to transplant, for the first time, part of one man's eye to the eye of another, saving the sight of the latter. The results of this amazing operation, performed a few weeks ago, were reported satisfactory.

The sufferer in question, an inmate of the Home for the Blind, has one glass eye. The other eye was obscured by a cataract to a point where hardly any vision was left him. This eye was restored by grafting upon it the cornea—the transparent part of the coat of the eyeball—from the eye of a patient to whom it had been rendered useless by growth of a tumor.

The delicate operation had to be performed in record time to prevent the living tissue of the cornea from dying before it was transplanted to the eye of its new owner. When the bandages were removed, the patient's patched eye was found to have a vision of about ten feet.

Catch Birds in Fish Nets

PROBABLY the stupidest winged creature is the auk, a small, web-footed, penguinlike bird whose haunts are the Arctic regions. A Canadian zoologist, recently returned from the Far North, described the catching of droves of auks by Eskimos who were armed only with fish nets! The birds apparently cannot distinguish men from rocks.

The scientist estimated that he saw more than 100,000 auks on Hakkuyt Island alone. Their behavior, he said, is that of little soldiers on parade. They advance in long straight lines.



Invents New Front-Wheel Drive for Autos

ANOTHER attempt to apply the power of an automobile motor to the front wheels instead of the rear has been made recently by a French automobile engineer, M. Schaud. In the picture above, the casing of the main driving gear may be seen in the center of the complicated front axle, just below the radiator of the automobile. Power is applied to the wheels through a system of gears.

The close proximity of the driving wheels to the motor is expected to give greater efficiency by reducing loss of power in transmission. Front drive cars frequently have been built and a number have attained prominence on the race tracks, but they never have reached great popularity with the ordinary motorist because of the difficulty in steering them.

Where Half of the World's Gold Is Weighed

IN A stream of yellow ingots, more than half the gold produced in the world passes through the weighing rooms of a refinery at Germiston, near Johannesburg, South Africa. Unrefined blocks of gold representing a fortune are piled before the weighing official, who places them in the pans of sensitive scales, operating within dust-proof glass cases. The weight of each is recorded before native laborers carry them to the refining plant.

The latest figures available, those for 1926, reveal that the South African mines of the Transvaal produced more than \$200,000,000 worth of the precious mineral during that year. The total production for the world was valued at less than \$400,000,000. Of this amount, the mines of the United States yielded slightly more than \$40,000,000.



Weighing blocks of gold, each worth a small fortune, on delicate scales in the refinery near Johannesburg, Africa.

New Hand Truck Picks Up Piles of Boxes

BY PICKING up two stacks of boxes at a time, a new hand truck, invented in England, saves time by doing away with the necessity of loading each box on the truck separately. After the truck has been run into position, the wheels are held from rolling by application of a foot-brake. A hand lever then operates a pair of clamps at the front of the truck, causing them to grip the boxes at the bottom of the piles. The body of the truck, slightly wider than the two columns of boxes, holds the upper boxes in place while they are being wheeled. At the destination, the clamps are released and the boxes discharged in a neat pile.

Principle of Range Finder Applied to Depth Gage

THE principle of the range finder, used in war time to determine the distance of ships and airplanes, can be applied to a special form of microscope and employed in the laboratory for minute and accurate depth measurements. This was demonstrated recently by Dr. L. C. Grinnier, of the United States Bureau of Standards, before the American Optical Society.

He showed that the range finder consists of two telescopes with their main lenses some distance apart, but with their prisms arranged so that the observer sees the view through both telescopes at the same time. He sees the scene in circular form, divided across the center. The



A pair of mechanical arms, operated by lever grasp the bottom of the double pile of boxes.

upper half is the view through one telescope, the lower through the other. When the prisms are so adjusted that the object being measured is not split in the center, the actual distance may be read off a dial.

Now, the depth gage applies the identical principle, but two microscopes, instead of telescopes, are set at an angle of twenty-five degrees, so that both can be focused upon the same spot. The field also is divided, and when the instrument is set so that no break occurs, the depth can be measured to an accuracy of about one-tenth-thousandth of an inch.

"Beams" of Sound to Guide Aircraft in Fog

A "SOUND searchlight," described as throwing out a concentrated "beam" of sound that penetrates high into the air, as a shaft of light cuts into the darkness, was tested recently at Camden, N. J. The device is expected to prove valuable in directing aircraft to landing fields during fog when their line of approach is so close that the radio beams are becoming ineffective.

The so-called "sound searchlight" was invented by S. T. Williams, of the Victor Talking Machine Company. It consists of a cluster of nine conical horn units each carrying a loudspeaker. They are joined into a single straight-sided mouth, forming a rectangular box about eight feet square and twenty feet high. This box is mounted on pivots which, in

combination with the wheeled base, allow it to be pointed in any direction that may be desired.

During the test, the horn was mounted on top of a ten-story building and trained on the U. S. Army dirigible J-4, which circled overhead at an altitude of 1,300



Left: The "sound searchlight" at the U. S. Army dirigible J-4. Above: A view of the great loudspeaker horn.

feet. Officers of the airship reported they could hear every syllable of the directions spoken to them by men on the roof below. Further tests probably will be carried out soon with the Navy's rigid dirigible, *Los Angeles*.

A giant phonograph, thirty-one feet tall, which could be heard thirty blocks away, was built by the same company not long ago and described in *POPULAR SCIENCE MONTHLY*. The unique feature of the new horn, which makes it an advance over the stentorian phonograph, according to the inventor, is that it concentrates the sound waves instead of allowing them to scatter. Thus, the sound "beam" can be trained upon an object high in the air and, like a searchlight, can follow its flight. Guide ropes manipulated from the roof tilt the horn up and down and from side to side.

Speeding Typists' Fingers with Radio "Jazz"

A PSYCHOLOGIST connected with a Pennsylvania college not long ago conducted an experiment in which typists with their typewriters, kettledrums, saxophones, and plain, everyday pots and pans were used to prove his contention that human beings work better and faster amid the din produced by modern industrial centers than in solitude and quiet surroundings, as generally believed.

He placed a dozen typists with their machines in one of the classrooms and had them start a certain piece of work. After recording the time required to complete the job, he asked them to repeat the process. But this time a score of students with a variety of noise-making instruments were wheeled in and began to make an ear-splitting din. The girls not only finished the piece of typewriting in shorter time, he announced, but also with fewer mistakes.

The same idea seems to underlie the recent action of the officials of the Brooklyn, N. Y., plant of the Bush Terminal Company, who have had a radio installed in the main office. The tuning-in of any feature is permitted during working hours, but jazz music is given the preference, because, as one of the officials puts it, "it makes the typists' fingers move faster."

Screen Production Shows Motion of Planet

OUR neighbor planet Jupiter took the leading rôle, the other night, in a remarkable motion picture thrown on the screen in Washington, D. C. By an ingenious process, similar to that used in photographing budding flowers, its motions were so sped up that spectators saw Jupiter actually revolving, and one of its satellites or moons produce an eclipse before their eyes.

According to a plan worked out by Dr. C. E. K. Mees, of the Eastman Kodak Company Research Laboratory, successive exposures were made at regular intervals several minutes apart, on two or three nights. Then they were run off at standard movie speed, thus accelerating the motion enough to make it plainly visible. The pictures were taken by Prof. W. H. Wright through the telescope of the Lick Observatory.



Invisible Forces Photographed!



This one-tenth-second photo shows a 750,000-watt fluid jet jumping on pulsations in brilliant lightning forks.



Electric field around insulator in glass tank being photographed.

Left: An electric field as revealed by the camera. Tiny silk threads show lines of force.

FIRST photographs of the electric field around a conductor, made at Purdue University, promise to simplify enormously the problem of designing good high-voltage insulators and to aid in the study of what happens around a wire carrying electric current. They make it possible to see the direction of electric lines of force in the air that precede lightninglike discharge of sparks, replacing tedious calculations.

This "electric field" is normally invisible; but the investigators found that when they placed an electric cable or insulator in a glass tank filled with carbon tetrachloride, a transparent nonconducting liquid, and floated thousands of tiny shreds of artificial silk in it, the silk threads immediately lined up to give a perfect picture of direction of electric stresses. At the same time they showed along what path the current was most likely to jump off or to break down insulating material. A camera, set up over the tank, took pictures that will aid in making improved cables and insulators.

Tractor Sets 1,330-Mile Endurance Record

PLODDING along like the tortoise in the fable, a tractor, pulling a disk harrow over a thousand-acre field in California, set what is believed to be a world record recently when it kept going for seventeen nights and days.

The test was made by engineers of the University of California. During its long run, the tractor covered 1,330 miles and disked 1,280 acres. The only times the wheels stopped turning were for short periods four times a day when the tanks were filled with gasoline and oil. The motor was not stopped.

The only mechanical difficulty encountered was the loosening of a valve push rod. This was adjusted without stopping. The fuel consumption was 1,131 $\frac{1}{4}$ gallons; oil, 117 $\frac{1}{2}$ quarts.

Walls Hide Radiators in Novel Heating System

SMALL hot water pipes, buried in walls, ceilings, and floors of the new British Embassy, under construction in Washington, D. C., will furnish a novel heating system that eliminates the use of visible radiators. This is believed to be the first time the system has been installed in a building in this country, although frequently used in England.

In some of the rooms all four walls and the ceiling will be warmed. In others, heating the floor is expected to make the room comfortable. The British officials in charge of the construction decided against the familiar radiator, which has been widely employed since it was invented in 1885, on the ground that it takes up too much space and gives a less uniform heating to the room than a system of invisible pipes.

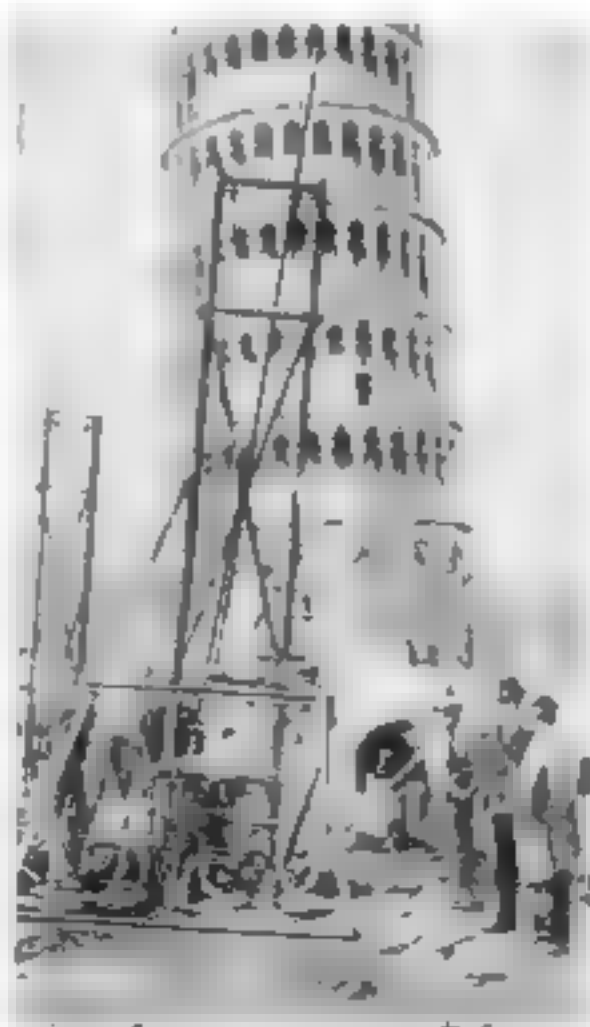
Bolstering Up the Leaning Tower of Pisa

CONCRETE is being forced under the foundation of the leaning tower of Pisa in Italy, in an effort to save the famous medieval structure. The tipping of the tower has increased steadily, and fear was felt for its safety.

When measured a hundred years ago, the tower was fifteen and one half feet out of the perpendicular. In 1910, it

was sixteen and one half feet. The foundation descends only ten feet into the ground. A recent survey was made of the subsoil underneath to see what strengthening measures could be undertaken. It was decided to force concrete under the walls, which are thirteen feet thick at the base.

The tower, with its eight stories, rises 179 feet, and is constructed throughout of marble. Experts who have studied it believe that the tower assumed its leaning position while under construction, early in the twelfth century, and that its designers did not intend it to lean.



Workmen are now here forcing concrete under the foundation of the leaning tower of Pisa, in an attempt to prevent its collapse.

Tests Show Canary Bird Is Best Gas Detector

THE United States Bureau of Mines, after experimenting with chickens, rabbits, dogs, mice, and other animals, has reached the conclusion that the canary is the best detector of poisonous gas in mines. In this connection, it will be remembered that Dr. Hugo Eckener, builder and commander of the *Graf Zeppelin*, had his pet canary aboard for this purpose when the world's largest dirigible made its recent trip from Germany to America and back.

The canary's fitness for the job lies in the fact that it falls from its perch the moment it breathes dangerous gases, but revives quickly when brought into the fresh air. It seldom dies from the effects, and can be exposed and revived many times within a short while without harm.

In the Bureau of Mines test, canaries, white mice, chickens, dogs, pigeons, sparrows, guinea pigs, and rabbits collapsed in the order named when breathing a small amount of carbon monoxide.

Why Two Sets May Look Alike, But Behave Differently

By JOHN CARR



THE two men in the seat behind me were having a hot argument.

"You sure gave me a bum steer when you recommended that lemon," one of them growled disgustedly. "About all that alleged radio set has is a swell cabinet. The rest of it's a bunch of junk!"

"Junk nothing!" asserted the other man heatedly. "My set works fine. doesn't it? How can your set be junk when it's exactly like mine? You must have a bad tube or something."

The man with the grievance laughed sarcastically. "Yeah," he glibbed, "it must be something, all right, but it sure isn't a bad tube. If all the tubes the dealer has tried in that set were laid end to end they'd reach from here to the middle of next March! The set's a flop, I tell you!"

I lost the rest of the conversation, for the train stopped just then and the two men got off. However, it's pretty safe to prophesy that the disgruntled chap will finally trade in or otherwise dispose of the unsatisfactory set and get another. And the new radio receiver undoubtedly will be of a different make than the old one.

Now what brought about this unfortunate incident? The fact that the two sets appeared to be identical would lead one naturally to believe that they should operate alike. Why, then, did they perform differently?

PREVIOUS articles in **POPULAR SCIENCE MONTHLY** have pointed out that location is all-important. A set that gives excellent results in one locality may not do nearly so well in another place only a short distance away. Every radio fan who has moved several times can testify to the variation in reception.

But aside from locality, there are other important reasons why radio sets that appear to be identical are not alike in performance.

The condition of the vacuum tubes in any set is so important that almost the first thing the service man does when he is called in to remedy trouble is to test the tubes. Obviously if one of two identical receivers is fitted with one or more tubes that are below par, and the other receiver has good tubes in every socket, there will be a great difference in results.

But even if the two receivers were fitted with good tubes, one of them might be, and often is, inferior as to sensitiveness and selectivity. Sometimes there is a pronounced difference in tone quality. The chief cause of such inferiority is lack of synchronization in the tuning of the radio-frequency stages. This breath-taking mouthful of words means, in plain language, that the parts of the poor receiver are lacking in "teamwork." Individually they may be stars, but collectively they don't work together.

You know, of course, that the weak radio impulse that reaches your set by way of the antenna is amplified or strengthened many times before it is con-

verted into the electrical equivalent of sound and the stationary ones is different in the different condensers. It takes only a slight error to cause trouble. The tiniest dent in one plate may be just enough to throw the tuning of that stage out of line with the other stages and result in cutting the sensitiveness of the receiver in half. And because the selectivity of a radio receiver, which is its ability to choose between stations, depends on the cumulative effect of several stages, this desirable quality may be seriously impaired.

OF COURSE, defects in the condensers are not always to blame for poor teamwork. Any irregularity in the winding of the coils will cause the same trouble.

For really satisfactory results, therefore, both the coils and the condensers must be manufactured with great accuracy; and since it would be extremely expensive to make them to precision standards, absolutely alike, some provision must be made for ironing out the slight differences after the set is fully assembled and ready for use.

And here is where mysterious differences occur. One set may be adjusted to get teamwork out of the parts, and another may not. The adjusting must be done by skilled workmen, and with radio sets selling at the prices that prevail this year, there naturally exists a temptation to slight this expensive but necessary adjustment.

In fact, several makes of receivers have failed to pass the tests of the Popular Science Institute of Standards because they were carelessly assembled.

A RADIO receiver is, after all, merely a piece of apparatus made of aluminum, brass, copper, iron, and various insulating materials, the total value of which as raw material is but a tiny fraction of its selling price. The remainder of the money that you spend pays for the manufacturing of this material into finished parts and for the handwork necessary to put these parts together properly and adjust them.

Now what can be done to make the parts do good teamwork if they are not working together? You, as the owner, can't do a thing about it unless you have a pretty fair understanding of the operation of each part. Lacking that knowledge, any "fiddling" you may do with the adjustments probably will result in making matters worse rather than better. And there is the chance, also, that the real trouble may be merely a matter of locality or poor tubes.



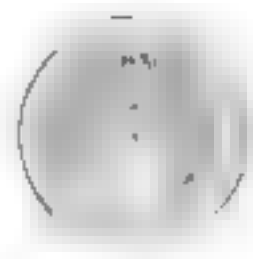
Even a slight bow or a faulty adjustment in the plates of one of the condensers may result in inferior broadcast reception.

verted into the electrical equivalent of sound that you can hear. This strengthening of the radio signal is accomplished by passing it through several circuits, each of which consists, essentially, of a vacuum tube, a coil of wire, and a queer-looking metal gadget with two sets of metal fins, called a condenser. You have noticed how some of these fins slide in between others without actually coming into contact, when you turn the knob that tunes the stations. Moving these fins, or condenser plates, governs the tuning of the individual stage of amplification. The same result could be obtained by changing the number of turns in the coil of wire, but it is mechanically more convenient to do the tuning by moving the condenser plates.

NOW when the parts of a radio receiver are not doing good teamwork, it simply means that the condenser plates are not all producing the same effect for any given amount of movement of the tuning control knob.

Sometimes the fins are not set at the same angle on the shaft, but more often the space between the moving fins or

IF YOUR present battery receiver is of comparatively recent make and gives good results, revamping the outfit along modern lines may well be worth while if you enjoy working with tools.



Rewiring for A. C. Simplified

Here You Can Learn When It Pays to Discard Batteries, and How to Change the Old Radio Set into an "Electric"

By ALFRED P. LANE

THOUSANDS of radio fans now are trying to decide what to do about their battery operated radio receivers. They ask: "Shall I get new batteries and keep on using my set as it is? Had I better scrap it and get a new electric model? Isn't there some way to make it over so it will be an electric?"

And the correct answer, curiously enough, may be either yes or no to any one of these three typical questions. It all depends on the particular set and the individual who owns it.

For instance, the receiver may be a very old one, poor in tone quality and obsolete in appearance. In such a case I would unhesitatingly recommend keeping the set just as it is until you can afford a whole new outfit, then scrap it and either buy or build a modern receiver. Don't waste time trying to revamp a really old receiver along modern lines. It doesn't pay. Too much has to be done to it.

On the other hand, the receiver may be of comparatively recent make and give its owner satisfactory results for distance, volume, and tone quality. In that case revamping the outfit along modern lines may be worth while or it may not, depending on the owner's ability to do the work involved.

Of course this problem cannot confront the man who lives where there is no electric light current. He must, perforce, be content with battery operation.

Don't expect to improve the operation of your radio set by rewiring it for full electric operation. A full electric set is

neither more sensitive nor more selective than the same set operated by batteries. The tone quality will not be changed, but if you have been operating the set on ninety volts with 201-A tubes in all sockets, you can greatly increase the volume on local stations with good tone quality by using a power tube type 171-A in the last audio stage. If your receiver is now equipped with a 171-A tube in the last stage, its operation after rewiring for alternating current tubes should be as good but no better than the results you now obtain from batteries.

Certain types of radio receivers, either because of the circuit employed or the tubes for which they are designed, are not good subjects for A. C. rewiring jobs. Among these may be listed practically all types of reflex sets and superheterodynes designed for use with the 199 type of tube.

The simplest way to obtain full electric operation with such receivers is to use an approved type of A and B eliminator. And the reflex circuits may give trouble even with eliminators.

REWIRING for full electric operation with the modern A. C. tubes is most successful with the various types of tuned-radio-frequency and neutrodyne receivers, provided they are not fitted with resistance coupled amplifiers. It is, of course, possible to operate a resistance coupled amplifier circuit with alternating current, but the simple circuit here described cannot be used. If you have a set using resistance coupled amplifiers, I

would recommend changing over to transformer coupled audio amplification so that you can use the methods outlined on these pages. Modern transformer coupled audio amplification will give practically as good tone quality as resistance coupling, and the principal advantage of resistance coupling, low B-current consumption, is of no importance in full electric operation.

THERE are many types of tuned-radio-frequency circuits, but they all boil down to a circuit similar to the one shown in Fig. 1. They may have fewer rheostats or even no rheostats of the hand adjustable type. The coils may be of different design, and there are many forms of balancing or oscillation control. The condensers may be lined up on a single control or they may be fitted to individual dials. The receiver may have six tubes instead of the five shown or it may, in the case of many home built receivers, have only a single stage of radio-frequency amplification.

These matters do not concern us in our rewiring job, for the method we will follow will work no matter how these details are arranged.

First you must get the necessary apparatus to perform the rewiring job. Here is the list:

A filament-heating transformer having three secondary windings giving 1½, 2½, and 5 volts. The 2½- and 5-volt windings must be center-tapped.

A high grade factory built or home assembled B-eliminator. (If you already have a B-eliminator that works well you

will not have to purchase another)

A socket for type 227 tube (five-prong).

A six-ohm potentiometer (*P* in Fig. 2).

A wire wound fixed resistance (*R1* in Fig. 2). The value in ohms of this resistance is determined by the number of 226 tubes in the circuit).

A wire wound fixed resistance (*R2* in Fig. 2).

A high resistance, noninductive, non-capacitive potentiometer (*V* in Fig. 2).

A one-microfarad by-pass condenser (use as explained below).

A supply of wire. Ordinary double cotton, paraffined bell wire will do, but the regular insulated radio hook-up wire is much better.

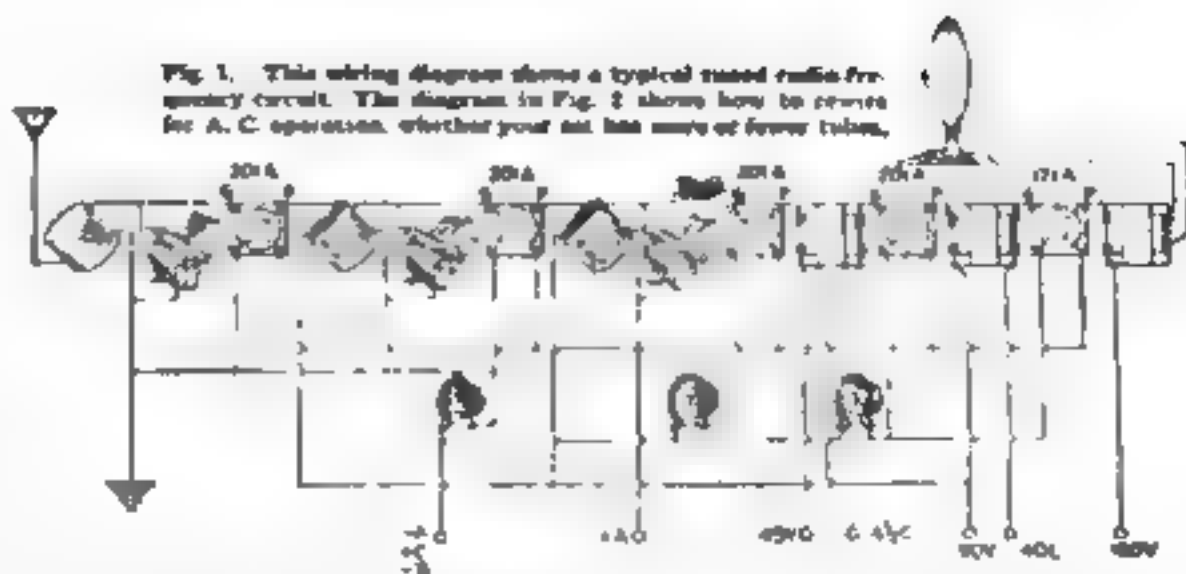
THE first job in the rewiring is to determine which tubes are connected in the various stages. If the receiver is home built, you can settle this question by referring to the diagram you used in wiring it. If it is a commercial set, there probably will be marks on the subpanel near each socket that will give you the desired information. The markings are abbreviated to "1st RF", "2nd RF", "Det.", "1st AF" and so on.

In any case your job is to locate the detector socket and the second or last audio socket. Sometimes, instead of marking the stages, the type numbers of the tubes which should be used are indicated. If the set is arranged for a type 171 tube in the last socket, there will be some marking to indicate this fact.

The detector socket always can be identified by the grid condenser and grid leak, which always are connected as close to the grid terminal of the socket as the arrangement of the apparatus will permit. The grid condenser is a small fixed condenser fitted with clips which hold the tubular grid leak.

WHEN you have definitely located the detector tube socket, replace it with the five-hole socket, as shown in Fig. 2. Note that the connection to the grid condenser and that to the *P* terminal of the first audio transformer are simply removed from the old four-hole socket and attached to the similarly marked binding posts on the new five-hole socket. Run a wire from the terminal of the new socket marked *K* to the nearest point on the wire leading from the metal frame of the variable condenser that tunes the detector circuit. By

Fig. 1. This wiring diagram shows a typical tuned radio frequency circuit. The diagram in Fig. 2 shows how to convert for A. C. operation, whether your set has more or fewer tubes.



carefully comparing the wiring in your receiver with Figs. 1 and 2, you will see how to do this.

The next step is to cut away all the filament wiring from the sockets. It is not necessary to remove this wiring from the receiver. In fact it should be left in place. Merely clip each wire at the socket terminal and then clip off a short piece of it so that there will be no chance of the loose end making an accidental contact. Also make sure that the wires will not sag and short circuit against some other wires in the set.

NOW connect two long pieces of wire to the two *H* terminals of the new socket you have installed for the detector tube, and twist these wires together like an ordinary twisted electric light cord. The other ends of the wires should be connected to the 2½-volt binding posts on the filament heating transformer, as shown in Fig. 2. Repeat the same operation for the socket that takes the 171A power tube, the last audio socket. As shown in Fig. 2, this twisted pair is connected to the 3-volt binding posts on the filament-heating transformer.

In the diagram of Fig. 2 there are three sockets marked for 226 tubes. In your set there may be only two if the set has only one stage of radio-frequency amplification (the usual four-tube set), or there may be four or even five if the set has a total of six or seven tubes.

It makes no difference how many 226 tubes there are. They should all be wired in parallel and connected to the 1½-volt binding posts

of the filament-heating transformer, as shown in Fig. 2. This completes the actual filament wiring. You can check your work up to this point by inserting the tubes in the sockets and putting the plug from the filament-heating transformer in the nearest electric light socket.

The next step is to connect the minus-*A* and plus-*A* binding posts together with a piece of wire. Then mount the potentiometer *P* at any convenient point back of the panel and connect the outer terminals to the wires leading from any socket in which a 226 tube is to be inserted. Be careful that you do not connect both wires from the potentiometer to the same socket wire. It is easy to make this mistake because the wires from the sockets are twisted together.

Now connect the center terminal of the potentiometer to one end of resistance *R1*. This resistance should have a value of 1,000 ohms if there are two 226 tubes in the receiver, 700 ohms for three 226 tubes, or 500 ohms if there are four 226 tubes.

The other end of resistance *R1* should be connected to the original filament wiring at the nearest convenient point.

IF THERE are only two 226 tubes in the set you may be able to get by without any by-pass condenser across *R1*, but if three or more 226 tubes are in the set you must use a one-microfarad by-pass condenser connected directly across the terminals of *R1*.

Now connect one end of resistance *R2*, which should have a value of 2,000 ohms if one 171A tube is used, to any convenient point on the original filament wiring.

The other end of resistance *R2* should be connected to the center terminal of the five-volt winding on the filament heating transformer.

The two resistances *R1* and *R2* are required to supply the necessary C-bias voltages on the radio- and audio-frequency amplifier tubes.

In some receivers, the *F* terminals of the audio-frequency transformers are connected to binding posts so that C-voltage may be applied. The diagram of Fig. 1 shows this arrangement. On other sets not using a C-battery, the *F* terminals of the audio transformers are connected to the minus side of the filament wiring. As shown in Fig. 2, the *F* terminals are connected to the old filament wiring at the nearest point. If there is any doubt about which are the *F* terminals, the same result can be accomplished by (Continued on page 149)

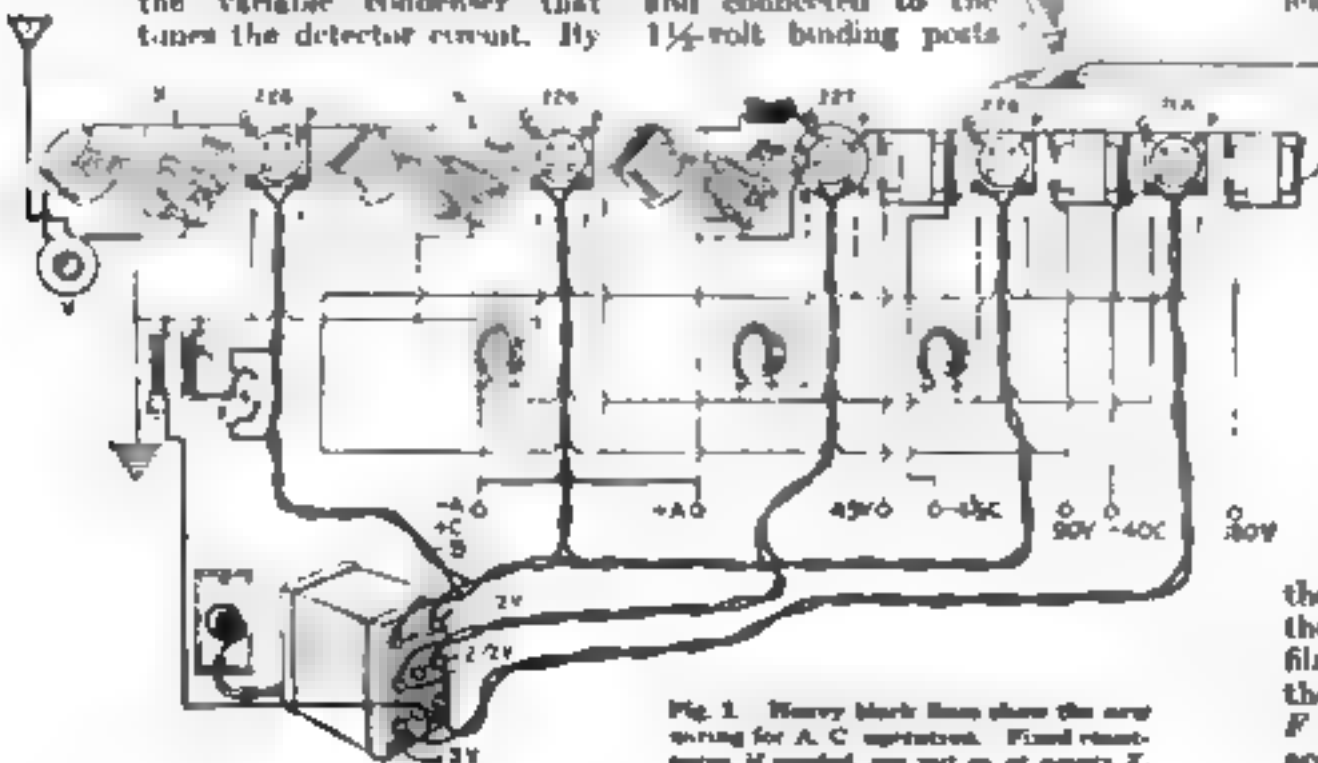


Fig. 2. Heavy black lines show the new wiring for A. C. operation. Fixed resistances, if needed, are put in at points *X*.

Timely Hints for the Radio Fan

A Useful Transformer Test

Headphones Aid in Fixing Position of Instruments to Avoid Coupling Trouble—Measuring the Life of a Storage Battery

THE audio transformer, as every radio experimenter knows, consists of a metal core made up of many layers of thin transformer steel on which are wound the primary and secondary windings. And there is no difference in principle between an audio transformer and the power transformer used in the modern electric radio receiver.

All alternating current transformers operate by electromagnetic action. In use, the core of the transformer is surrounded at all times by magnetic lines of force. Of course, with the usual closed core type of transformer, this external magnetic field is relatively very weak, but in the sensitive circuits of the audio amplifier end of a radio receiver, these weak external fields may cause considerable trouble.

There is even more chance for trouble in the modern full electric radio receivers, especially if the external field of the power or filament-heating transformer is acting on the core of one or both of the audio transformers. In such a case there will be a noticeable hum from the loudspeaker no matter how carefully the other parts of the circuit are worked out.

The rule-of-thumb method of setting audio transformers so that they will not couple together is to place them with the cores at right angles. This rule is a good one, and so is the caution to have the transformers as far apart as the layout will permit.

However, there is a simple method by which you can find just how to set any two transformers so that there will be no interaction between them.

NO APPARATUS is required except an ordinary pair of headphones. Assuming that you have 110-volt alternating current available, connect the ends of a drop cord to the primary winding of one transformer and insert the plug in the nearest electric light socket. Then connect the tips of the headphone cord to the primary or secondary terminals of the other audio transformer.

Now place the two transformers close together and you will find that you can hear a noticeable hum in the headphones. The illustration on this page shows a test of this kind being carried out in the laboratory of the Popular Science Institute of Standards.

As you move one or the other of the transformers you will notice that the intensity of the hum changes, and you

Using headphones to determine position for transformers where the hum disappears



will be able to find several positions for the transformers where the hum entirely disappears.

Of course the advantage of making such a test is that you can place the transformers so near each other that they are almost touching, and yet have no interaction.

The same method can be followed to find where to place audio transformers so that they will not be affected by the power or filament-heating transformer. Simply plug the power or filament-heating transformer cord into the light socket and connect the headphone cord tips to the audio transformer.

In fact, this method will

prove useful at many points in laying out apparatus for home constructed radio receivers and power or B-eliminator units. Audio-frequency choke coils, for instance, can be so placed in a B-eliminator circuit that there will be no interaction to reduce their effectiveness in filtering out the alternating current hum.

You can apply 110-volt alternating current to the primary or secondary of any audio transformer or to the terminals of any B-eliminator choke coil without danger of burning out the winding if the terminals of the remaining winding are left unconnected. A piece of wire connected across the terminals of one winding, while 110 volts alternating current is applied to the other, will result in a burn-out, of course.

When Batteries Play Out

AN OUTSTANDING characteristic of the lead-acid type storage battery as used in all automobiles for starting and lighting, and as the A-battery to supply filament current for a radio receiver, is the remarkable service it gives while it is reasonably new. It will stand around for weeks at a time partly charged and, perhaps, with the water level below the tops of the plates, and yet give good service.

The day of reckoning comes rather suddenly. Some evening the radio goes dead, and you discover that the battery is completely discharged. Then, after you give it a long charge, it works well for a time, when the same thing happens again.

From then on, life seems to be one continual round of having the battery charged and having it go dead just when you want it most.

The useful life of any storage battery is governed by the care you give it. It may last less than a year, or it may give four or five years of good service. But no matter how careful you are, it won't last much longer than five years.

When a battery must be charged every two or three days even when not used, it has outlived its usefulness and should be replaced. No amount of charging or attention will bring a decaying storage battery back to life again.

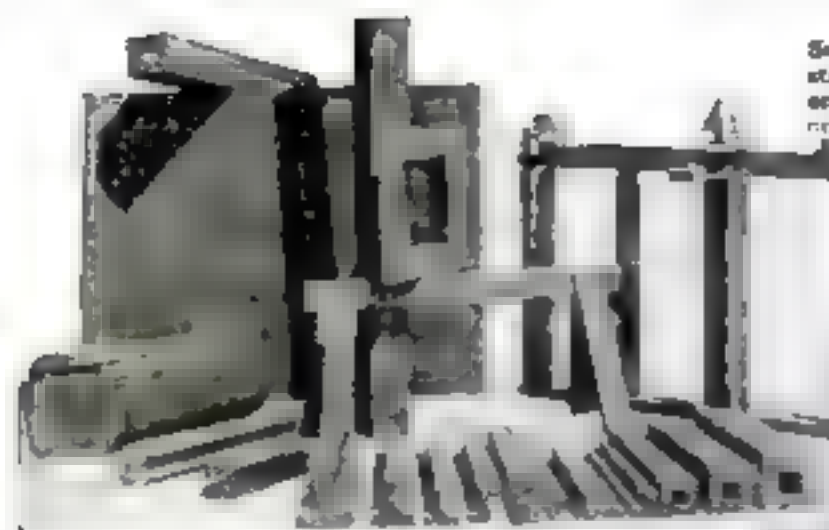
To prolong the life of your storage A-battery, do not let it become discharged below 1,200 on the hydrometer. It is better to give it a small charge once a week than to let it go two weeks between charges.

A B C's of Radio

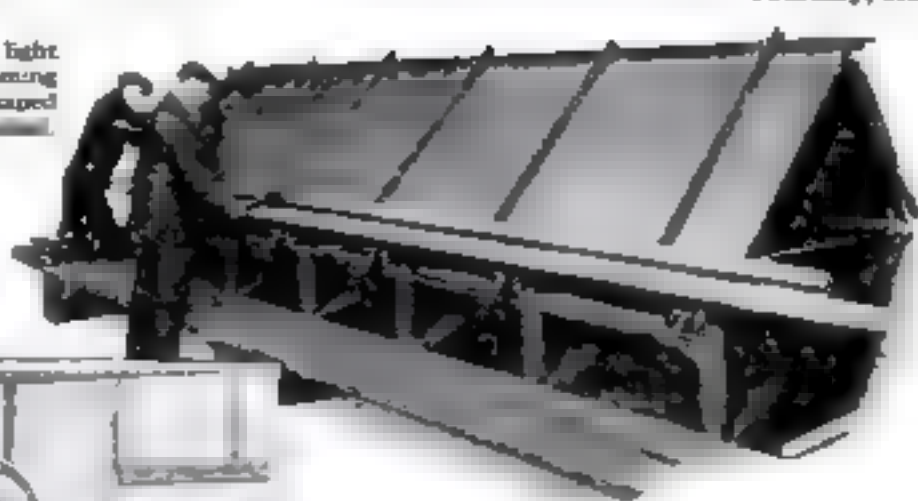
WHILE alternating current operation, as compared with battery operation, affords no better results in the radio-frequency detector, and first audio stages of a receiver, it is a big help in the last audio stage.

Working from an alternating current source, you can easily obtain the necessary high B-voltages required for best results when you use modern power tubes. And these tubes definitely improve tone quality, especially when you want plenty of volume.

Of course, any desired B-voltage can be obtained from B-batteries if you use a sufficient number of them connected in series, but this becomes an expensive method if you go beyond 120 volts.



Samples of light structural framing and truss of shaped rice piers.



This special "loom" makes flooring out of waste strips left from cutting the new lumber.

Fabricated Lumber Cut in Labor-Saving Shapes

"WHY cut a tree to pieces and then pay a carpenter money to put it together again?"

That is the pertinent question put by Ross Houston, veteran lumberman of Tacoma, Wash., who recently developed and patented a unique labor-saving plan for sawing logs. His system produces "fabricated" or shaped lumber instead of flat boards and square beams, now the standard product of lumber mills.

Just as steel girders are formed for convenience in "I" and "T" shapes, Houston cuts boards in one-piece slabs in L's, X's, and T's—each for a special purpose. He claims striking economies for his solid lumber shapes.

For instance, the post at the corner of an ordinary dwelling is usually made, today, by nailing together three two-by-fours. The Houston house corner, a solid beam with a cross section resembling a humped letter "L," has ample nailing surface but contains a seventh less lumber. That means a saving of wood and of freight charges, besides eliminating the usual nailing. A window frame now requires eight pieces of lumber and as many outside joints, but four of Houston's "L's," without outside joints or

Stunning Gowns of Metal Soon May Be the Style

IF EXPERIMENTS made recently by German manufacturers prove practicable and popular, women soon may go to dances and the opera in stunning evening gowns of metal, while their escorts will be clad in a modern adaptation of the suits of armor worn by knights of old.

Flexible fabrics containing layers of metallic foil have been perfected; and the next step, the German experts declare, will be the making of clothes of aluminum—waterproof in wet weather and heat-proof in summer, like the aluminum paint on the exterior of a Zeppelin dirigible.

Thin sheets of aluminum, resembling tin foil or gold foil, are coated on both sides with protective material not unlike the plastic substances used in manufacturing rayon. This fabric is said to be almost as light as silk, tough as leather, waterproof as rubber, and bright and heat-reflecting as aluminum. Of this material, raincoats, umbrellas, and even dresses and business suits may be made.

Not only striking frocks for women, but also beautiful effects in household decoration will be obtainable in the new fabrics, the experimenters predict.



Installing one-piece fabricated partition top. Inset shows cross section of house corner.

nailing, suffice. Other shapes are conveniently adapted for partition trees, table tops, fence caps, and crates. There are four hundred possible shapes so far.

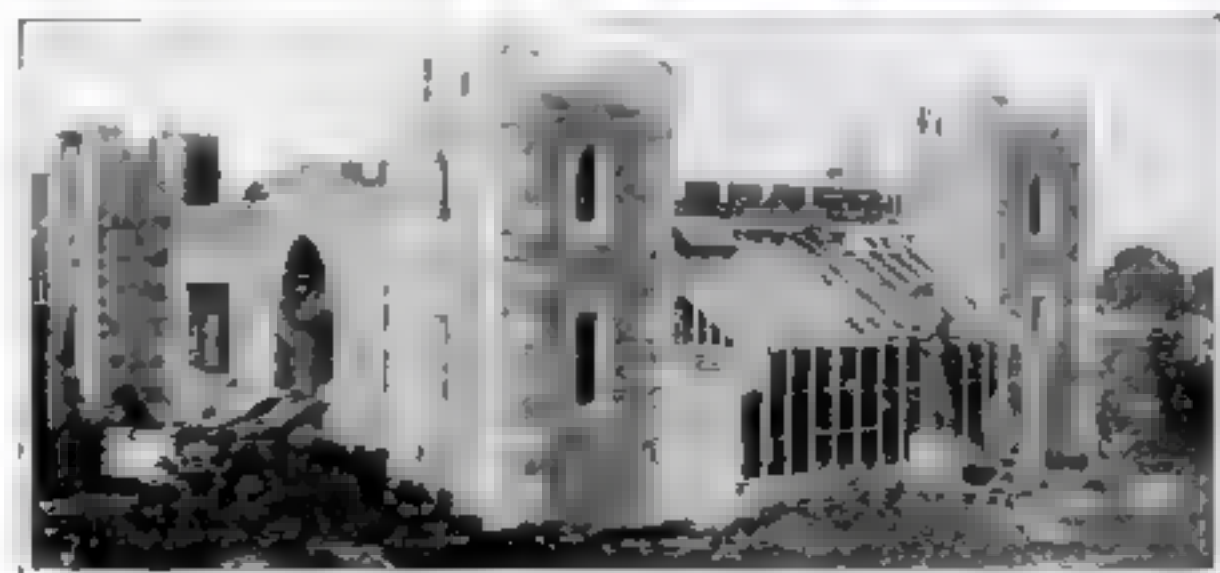
The inventor plans to introduce his new system in lumber mills throughout the country. The one-piece slabs, he says, are as strong as nailed shapes and do not crack or warp.

Profits from use of his labor-saving material, Houston says, offset many times the slight added cost of making it at the sawmill. The secret of its manufacture is simple. Sawing at angles into a log, instead of straight from the side,

He Built His Own Castle—On the Ground

A PRIVATE little castle, complete with towers and battlements, as well as a conservatory for raising flowers during winter months, has been constructed by T. Martin, a chauffeur in Hookwood, Surrey, England. During a period of unemployment, he planned and built the unique dwelling, making with his own

hands all of the concrete blocks which went into its walls. It took eleven months to complete the imposing structure, from the foundation to the finishing touches on the conservatory. The unusual building, patterned after medieval architecture, has been given the name of "Hookwood Castle" by people living in the vicinity.



The builder is seen at the right putting the finishing touches on the glazed conservatory of the remarkable little castle he constructed with his own hands. He did the job in eleven months.

New Experiment Confirms Findings of Einstein

PROF. A. A. MICHELSON, University of Chicago physicist, has just repeated his memorable experiment of forty years ago, which later served as the basis of the much-discussed Einstein theory of relativity. The results, recently announced, completely confirm the test he then made with the aid of the late Prof. Edward W. Morley.

The Michelson-Morley experiment, which has been the subject of the most heated scientific controversy, was intended to discover whether there exists a hypothetical "ether," through which the world moves. Two beams of light were made to run a race. They were shot out at right angles to each other, reflected back to their source, and their arrival timed. Had one beaten the other, an "ether drift" would have been proved, but a "dead heat" which actually resulted could not be explained until Einstein proposed his remarkable theory.

Now experiments conducted on Mount Wilson, Calif., with instruments ten times as accurate as the first, vindicate both the former experiment and Einstein's findings. That Einstein was fortunate enough to make a correct theory grow from wrong assumptions at the beginning, is Prof. Michelson's conclusion.

Amazing Machines Do Work of an Office Force

AN ALMOST complete "automat" office force was recently assembled by technicians at the National Business Snow and Printing Co. in Chicago. The electric typewriter can be set to type a long and letter and will keep on typing out copy as it is stamped. Among the automats' functions were machines that dictated, copy and check their answers, and an adding automaton set to solve problems in algebra, geometry and trigonometry. A mechanical mark makes ledgers and statements.

Suspended by Crane, House Rides across River

HOUSES have been carried down streets and across bridges in odd moving jobs, but it remained for a Dutch contractor to accomplish the amazing feat of carrying one bodily across a river. He succeeded in lifting a Rotterdam bungalow with

a huge floating crane and ferrying it across the River Maas to its new location without injury. Extreme care was required to keep the house from breaking apart. The structure was firmly braced with cross girders, two of which, fastened above the roof, served for anchoring lifting cables.

Put Milk in the Dark to Keep It Fresh

EXPERIMENTS by the Bureau of Dairy Industry of the U. S. Department of Agriculture show milk must be kept in a dark place to retain its flavor and freshness.

When exposed to sunlight, milk quickly develops "a linseed oil odor and a cardboard taste," the chemists found. This is because the light acts as a catalyst, causing oxidation. Of duplicate milk samples used in the test, those kept in the dark developed no off flavors or odors, even after seven to nine days, during which they remained fresh at a near-freezing temperature. Samples kept at the same temperature in sunlight developed unpleasant smell.

Handy Radio Aerial Mast Clamps to the Roof

DESIGNED to clamp on chimneys, around gutters and eaves, on apartment house parapets, or on window sills, a new radio aerial support has been put upon the market. Instead of having

sticks in the roof, which are liable to break, this new device is made of brass, radio owner can save time and trouble, says the inventor. A case of the new device which can ports in a room and can be attached to an isolator. When the support is screw it screw in place a set and a screw for the new device can be inserted in a house and then.



The aerial mast attaches to peak of gutter eave. Note clamp on side of attached.



"Fountain Pen" Pistol Can Shoot Deadly Bullets

A "FOUNTAIN PEN" that spouts a thirty-eight-caliber bullets was picked up near a street corner in New York City recently and turned over to the police. The tiny weapon, little longer than the width of a man's hand, is shaped to appear merely a harmless writing instrument. A few feet away, it would be mistaken for a real pen. Only when it is examined closely does the open muzzle at one end reveal its dangerous character.

A comparison between the dimensions of the strange weapon and the muzzle that it shoots is being made by the two officers in the picture. The pistol unscrews in the middle to insert the cartridge. It is fired by pressing a small button about the size of a pinhead in the end of the weapon. This releases a spring that operates the firing pin.

Urge Metal Storage for War Needs

THE ancient Assyrians stored huge quantities of iron in times of peace to have a plentiful supply for the manufacture of arms to be used in their frequent wars.

A similar method is advocated by U. S. Army officials for present-day America. There are nine minerals, they say, which this country would not possess sufficient stores in case of sudden hostilities. These are manganese, which forms an alloy with steel and hardens it; antimony, which hardens lead; chromium, another steel alloy; platinum, used in chemical processes; nickel, needed for armor plate and bullet jackets; quicksilver, used in explosives, thermometers, and for several other purposes; tungsten, needed in the manufacture of electric lamps and machine tools; tin, principally used by the Army and Navy as a coating for cans; and nitrates, required in the making of artificial fertilizer.



How the floating crane picked up a bungalow and carried it across the Maas River in Holland. Steel cables from the crane were fastened to cross-girders attached above the roof of the dwelling.

Nobility Not Degenerate, Genealogists Assert

IN 1385 two English barons, meeting casually during the invasion of Scotland, discovered to their discomfiture that they bore the identical family colors. Each hotly disputed the other's right to them, and a long drawn out battle followed before a court of chivalry.

This fight, known in English history as the Scrope-Grosvenor suit, marked the beginning of the science of genealogy, which has been occupied with the tracing of lineages ever since.

In this country, genealogy is a comparatively new pursuit, but there is an organization, known as the American Genetic Association, whose members devote themselves to this interesting study, which has proved a great aid to historians.

At a recent gathering of the Association in Washington, a prominent genealogist declared that, contrary to popular impression, royalty and old families do not die out because of their age, or become degenerate and sterile on account of wealth and power. The fact that certain distinguished names no longer appear in the British peerage, he said, is due to a preponderance of female descendants.



He Made American Flag of 33,000 Wheat Kernels

GLUING kernels of wheat upon a board for the equivalent of seventy working days, twenty-two-year-old Theophile Casaubon, of Los Angeles, produced this reproduction of the American flag. He used 33,000 kernels of selected hard wheat in the process.

The flag is four feet long and two feet five inches wide and is set in a background of natural colored wheat kernels. Each of the colored grains of wheat had to be dipped in oil paint three times to obtain the proper shade before it was glued in place. All of this painstaking work was done with just a single tool—a pair of small tweezers.

Would Foil Bank Robbers

A CAGE for bank tellers and cashiers, constructed with shutters which could be closed instantly by bank officials by a push button on the approach of a holdup man, was proposed recently to prevent bank robberies. The idea was advanced by an expert in such matters—a holdup man serving a life sentence in the Iowa State Penitentiary!



A Mechanical Substitute for Tailor's Shears

INSTEAD of snipping along a line with scissors, tailors can cut out clothes in a fraction of the time, it is claimed, by use of the new mechanical cloth cutter pictured above. The machine is housed in a small box, above which a guarded blade protrudes. The device is started by simply plugging into a light socket and turning a switch.

The material, marked with chalk to guide the cutting, is fed to the guarded blade, which cuts rapidly along the line at any angle or curve. The inventor believes the machine will prove valuable to tailors and small manufacturers by reducing the time necessary to cut garments.

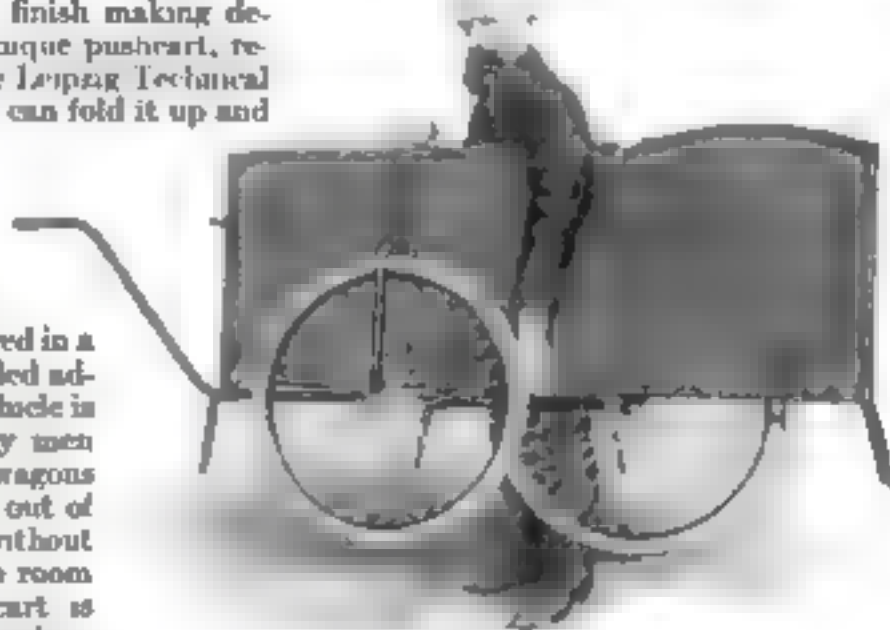
New Comet Discovered by an Amateur

AN AMATEUR astronomer living at Rosebank, a small community near Cape Town, South Africa, distinguished himself recently by the discovery of a new comet. His "find" was confirmed immediately by officials of the Union Observatory in Cape Town.

The comet could not be seen with the naked eye. It traveled slowly, and had no tail. The astronomers of the observatory plan to name it the Forbes comet, after its discoverer, and as encouragement to amateurs.

Folding Pushcart Runs on Rubber-Tired Wheels

WHEN tradesmen finish making deliveries with a unique pushcart, recently exhibited at the Leipzig Technical Fair in Germany, they can fold it up and tuck it under their arms. When the bottom is lifted the cart folds together in the manner shown in the photograph, and may be stored in a narrow space. An added advantage of the new vehicle is that it allows delivery men returning with empty wagons to walk on sidewalks, out of the danger of traffic without taking up most of the room on the walk. The cart is said to be virtually noiseless, since it is equipped with rubber-tired, ball-bearing wheels.



When the peddler has disposed of his wares, he simply folds the new rubber-tired cart and hugs it home under his arm.

Europe May Soon "Eat" Its "Drinks" in Solid Form

COUNTRIES now "wet" may soon go "dry" or partly so, but not as a result of international prohibition.

The taking of "beverage" alcohol in solid form—in other words, the "eating" of "drinks"—has been made possible through a new German invention, which was demonstrated at one of the principal laboratories in Berlin a few weeks ago.

Alcohol in solid form is an old story to the chemist, but heretofore the chemicals used to turn it into a solid mass were inedible and often poisonous. But the new German material is reported to be non-injurious and without taste or odor. Technically known as potassium-alpha-diacetone-fructose-sulphate, it is nothing more or less than fruit sugar treated by a process, the secret of which is jealously guarded by its inventors.

The principal commercial benefit to be derived from the invention will be the greater ease with which alcohol and alcoholic liquids such as the bases of many drugs and toilet preparations—can now be stored and transported.

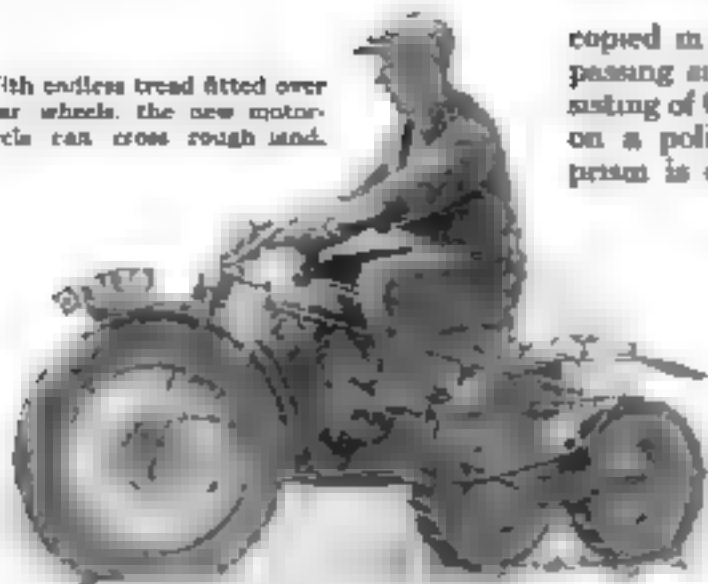
Gives American "Talkies" Foreign Tongue

WHEN the "talking movies" first made their appearance, some leaders in motion picture affairs asked, "Won't this innovation seriously curtail the export of American-made films to foreign, non-English-speaking countries?"

Edwin Hopkins, a New York playwright, has supplied the potential answer with an invention which he calls "vivigraphie films," which makes it possible to connect a voice record of an actor speaking in a foreign language with an American moving picture film. The adjustment effected by the new device, its inventor claims, is so delicate that synchronization between the foreign sounds and the American lip-movements on the screen is almost perfect.

Another benefit is that popular movie stars who look much better than they sound need not lose their jobs. In such cases, the "vivigraph" would supply the voices of actors or actresses who sound better than they look.

With endless tread fitted over rear wheels, the new motorcycle can cross rough land.



Three-Wheeled Motorcycle Runs on Endless Tread

A MOTORCYCLE in which two small, doughnutlike wheels replace the single large rear wheel, has been designed in England for use in rough country and on unimproved roads. An endless tread is placed over the two rear wheels to furnish traction over especially difficult trails. The tread can be removed from the wheels and carried in the repair kit after a difficult stretch has been crossed, just as a motorist can remove his tire chains when solid road is reached. Extra large balloon tires absorb much of the shock of the bumps.

The machine is designed for the use of army and colonial officers stationed in undeveloped parts of the British Empire.

Tiny Ocean Plants Build Houses of Health Glass

IN THE Antarctic regions now being explored by the Byrd expedition live billions of microscopic plants which build transparent houses for themselves of materials so rare and difficult to manufacture that King Ceresus himself would have been too poor to fashion even a small palace from them.

The tiny plants, known to botanists as diatoms, construct miniature shells from silica and quartz which they extract from the sea water, in every square inch of which they live by the millions. When they die, their little "houses" sink to the bottom, and so numerous are the little plants that this material covers the ocean floor for a half million square miles.

The same substance has been smelted by electrical engineers in the making of lenses and of window panes which admit the sun's ultra-violet rays. A small window consisting of this transparent quartz is worth several hundred dollars.

Paints First Scientific Portrait of Spectrum

WITH the assistance of Dr. Irwin G. Priest and other scientists of the U. S. Bureau of Standards, Charles Bittinger, a noted artist of Boston, Mass., has painted what is considered the first scientifically accurate "portrait" of the spectrum of the sun.

In one of the laboratories of the Bureau, the scientists assisted Bittinger in selecting the colors that most accurately represented the spectrum. The spectrum

copied in the painting was obtained by passing sunlight through a grating consisting of thousands of fine lines scratched on a polished metal surface. A glass prism is often used instead of a grating to form a spectrum.

Landmarks' Guide Pigeons Home?

CONTRARY to accepted belief, bees, carrier pigeons, and other "homing" animals have no innate sense of direction, according to Armand Rio, a French naturalist. They find their way back to their hives or lofts by familiar landmarks which they memorize by short excursions within eye-range of their starting point before they set out on their flights, he says.

The carrier pigeons which make the longest flights are the ones with the keenest eyes, the best memories, and the greatest flying endurance. Ants find their way to their nests by remembrance of landmarks, he adds; and the same has been observed of barnacles under water, though these depend largely on touch.

Find Rare Handwork of Cave Men Jewelers

THE Neanderthal man, pictured by scientists as a flat-skulled, somewhat apelike individual who wooed his bride with a stone club, was a craftsman of no mean ability. Equipped with flint tools of the roughest and most primitive description, he nevertheless turned out articles for his daily use so delicately wrought as to challenge the skill of the most accomplished modern artisan.

Evidence of his proficiency was recently found in the shape of two rare scraper knives fashioned from rock crystal that were unearthed by the American School of Prehistoric Research party which has completed excavating the rock shelter, Abri des Mervilles, located in the Dordogne region of France at Castel-Merle.

These prehistoric implements, scientists say, are tens of thousands of years old. One of them is made of topaz of such beauty that it is a jewel as well as a weapon. The other, though not so fine in color, is of a workmanship which no living worker in quartz could rival.

The discoveries were made by Professor and Mrs. George Grant MacCurdy, of Yale University, and nine students.



Novel Card Table Serves Also as Movie Screen

A CARD party can be changed into a movie show merely by lifting the top of a new card table, switching out the lights and turning on the home projector. The table is designed to serve as a motion picture screen when it is not in use in its ordinary capacity.

The top of the table is formed by two thicknesses, one on top of the other, and hinged at one side. The upper layer swings up, its under side forming the screen. It is held solidly in position by a

stay while the pictures are being shown. The table can be folded easily and occupies little room when stored away.

Dry Cell Blasting Device Resembles Flashlight

FUSES, for blasting, are supplanted by a new device which resembles an ordinary flashlight and furnishes electric current from three dry cells to discharge the explosive. According to the makers, it eliminates the danger of misfires and delayed fires caused by fuse trouble.

The firing unit of the device is a special plug to which are attached wires leading to the blasting cap. To fire the blast, it is necessary simply to insert this plug in a small socket in one end of the device and hold it there, exerting pressure against a spring inside, thus closing the electric circuit. Releasing the plug breaks the circuit. A ring at one end of the case makes it possible to hang the blasting unit at the belt.



Pushing the plug into a socket at one end completes the electric circuit and fires the charge.



Swinging Auto Crib Rocks the Baby to Sleep

BUMPS and jolts on rough roads rock the baby to sleep instead of disturbing him, when he is riding in a new automobile crib, according to the inventor. The crib hangs, hammock fashion, in the rear of the car, supported by two hooks screwed into the crossbeams of the car top. The heavy duck cloth of which it is made is held in rigid shape by plywood bottom and a wire frame. The height of the crib above the floor is adjusted through chains by which it is hung from the hooks.

A spring cushion in the bottom is made in three hinged sections, which can be adjusted to give the proper support whether the baby is sitting or lying down. The total weight of the apparatus is six pounds. It may be placed to one side in the rear of a closed car, as in the photograph, or it may be hung crosswise just behind the front seat. In an open car which has a metal top frame, it can be attached to the frame by means of straps.

The crib can also be hung from a stand on lawn or porch as an ordinary sleeping crib, or attached to the ridge pole of a tent or a tree limb to provide a comfortable sleeping place for baby when camping.

One Time in Five It's the Train That Is Hit

IN ONE out of five grade crossing accidents, the automobile crashes into the train instead of the train hitting the machine, announces the American Railway Association, summarizing the annual toll of such accidents. In many cases the drivers first crashed through the crossing gate before hitting the train. During 1927, says the report, there was an increase of sixty-six grade crossing accidents over the twelve months preceding.

Road Signs Teach Geology

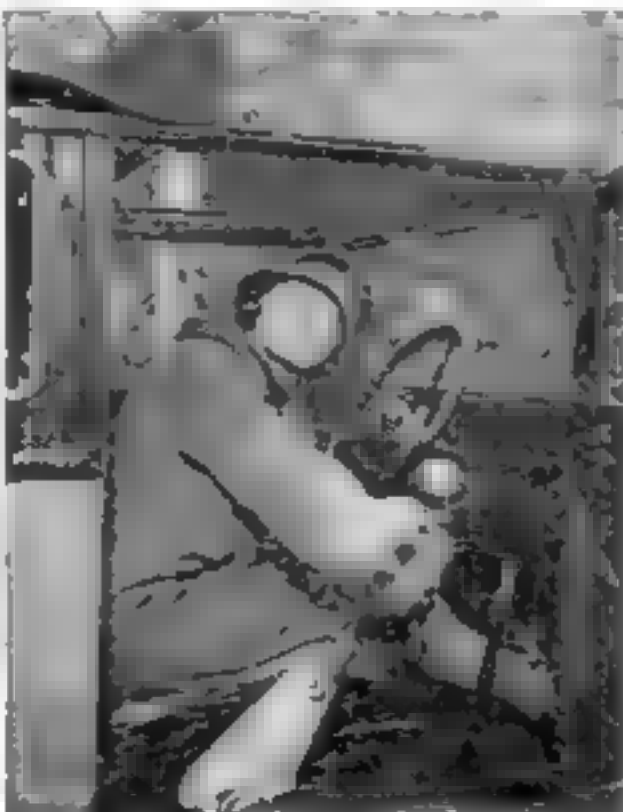
SIGNS placed along the highways near Ardmore, Oklahoma, call attention to interesting geological formations along the road, giving the kind of rock and the age it represents.

One signboard contains a diagrammatic cross section of the Arbuckle

Mountains, over which a main highway climbs. In constructing this road, many ledges were blasted away, revealing the rock formations. These serve as illustrations for which the signs form a text. Oklahoma is particularly interested in geology because its annual income of \$340,000,000 from petroleum products is largely due to the efforts of workers in this particular field of science.

Closed Car Has Removable Top to Admit Sunshine

ACLOSED car with a top that can be folded back to admit, through glass windows, the beneficial rays from the sun, was one of the exhibits of a recent automobile show in London, England. By moving a handle at the right of his seat, the driver can push back the canvas cover of the car like a curtain, exposing a roof of health glass. Thus the occupants enjoy the equivalent of riding in the open, while still protected from wind and cold. The device also provides sight-seers with a view of mountain tops or city skyscrapers.



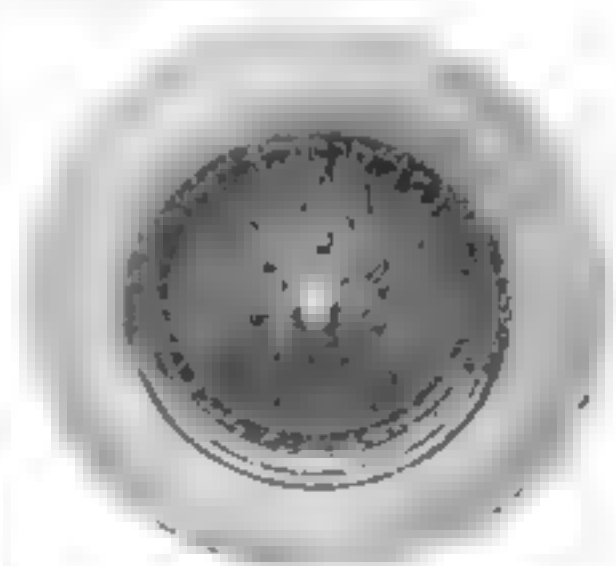
The driver, by pulling a handy lever, rolls back the canvas top of the car, exposing a glass skylight.

Holland Tunnel Handles 8,500,000 Cars in a Year

EIGHT and a half million automobiles, carrying 42,000,000 passengers, passed through the Holland Tunnel, under the Hudson between New York and Jersey City, during the first year of its operation, officials report.

Some of the elaborate tests made before the tunnel was built to insure against carbon monoxide poisoning have been revealed by A. C. Fieldner, of the U. S. Bureau of Mines. When the tunnel was proposed, it was suggested that a steady stream of cars might give off more carbon monoxide than could be carried away. The Bureau of Mines constructed an experimental tunnel, 400 feet long, in a mine near Pittsburgh, Pa. Small automobiles ran back and forth in it for hours while tests revealed the best method of introducing fresh air and removing contaminated air. The most efficient method was found to be admitting the fresh air at the bottom and removing the poisoned air at the top. This system was applied to the Holland Tunnel.

An automatic device that analyzes the carbon monoxide content of the air, and rings a bell and flashes a light if it becomes more than the safe limit of four parts in 10,000, was developed and installed in the tunnel. Besides, a series of fourteen instruments, placed at the ducts leading away the contaminated air, automatically record the poison gas content. If the records show more than two and a half parts gas to 10,000 parts of air, the fans are immediately speeded up.



"Auto Wheel Minus a Hub" Designed to Save Weight

A WIRE automobile wheel without the usual central shell that fits over the axle hub is one of the latest innovations in motordom. The wheel is said to weigh only eleven pounds. A similar wheel, with the usual hub, weighs eighteen.

Seven small metal rings, or eyelets, securing the inner spokes, and one large one, holding the outer spokes, take the place of the ordinary wheel hub. The small eyelets fit over the studs of the brake drums, where they bolt in place, tightening the inner spokes. When these seven bolts are drawn up tightly, a large cap on the outside of the wheel presses against the fixed hub of the car's axle. The wheel and the car axle hub are thus locked tightly together. In tests, the wheel is said to have shown remarkable strength.

Bird's-Eye View from Plane Reveals Buried City

ONE of the most paradoxical developments of modern science is found in the fact that aviation is proving itself a useful aid to archeology!

There are many archeological "clues," such as ancient roads, ditches, and the like, which are invisible to the passer-by on the ground, but which can be discovered from a height in the air because the aviator's bird's-eye view of the territory gives him an opportunity to observe conditions which form a scientifically unmistakable pattern.

A case in point was the recent discovery in this manner of the site of a Roman town somewhere in England. Leading British archeologists believe that beneath this site they will be able to unearth a complete city of Caesar's time, and they hope that, when excavations actually begin, they will find streets, houses, temples, arenas, and other treasures.

The scientists now preparing exploration plans which will bring this latest great archeological find to light decline to reveal the exact location of the mysterious city of antiquity until their arrangements have been completed. Meanwhile, unsuspecting persons are walking daily over this rich historic treasure-trove.



Inflates Soft Tire with Air from the "Spare"

A SPARE tire becomes a service station that travels along with you to supply free air for soft tires, through the use of a new "tire balancer," devised by Tom McNay, of Los Angeles, Calif. The device is extremely simple. It consists of a twelve-foot rubber hose with a cap at each end. These caps fit over the valves of two tires, opening them so the air can flow from the tire with higher pressure to the one with lower. In this way, also, the four tires of a car can be equalized in pressure to maintain the highest efficiency of four-wheel brakes, now standard equipment on all new cars.

When the hose is connected with a soft tire and the hard spare tire, it allows air from the spare to pump up the flat tire so it can be driven to a service station for complete air service, or filled more easily with a hand pump, if a motor-driven pump is not available.



Oregon Village Sees Its First Automobile

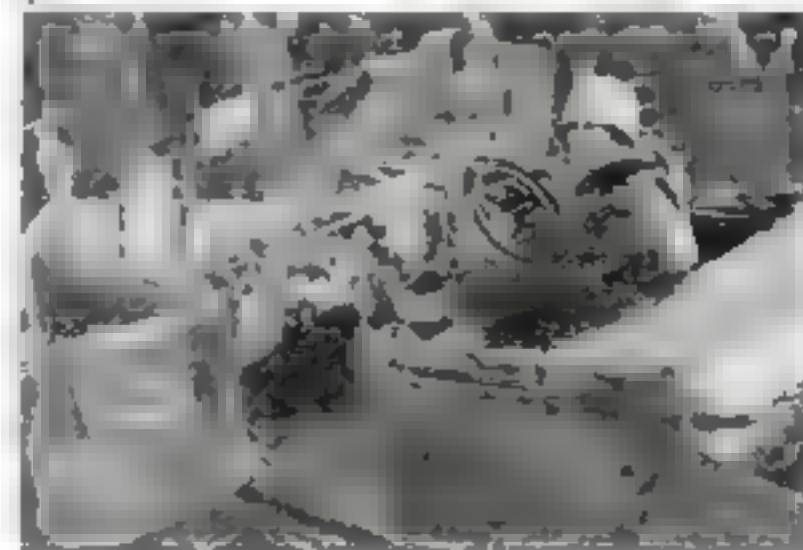
ALTHOUGH more than twenty million pleasure automobiles were on the roads of the United States last year, the village of Agness, Ore., had never seen one until a roadster was sent there the other day. This community, on the Rogue River in the southwestern part of the state, contains only a handful of people and uses the river as its main highway. Grown children there had never seen a motor car of any sort. Then a dealer sent one of his cars up the river to give the village folk the thrill of their first auto ride.

To ship the automobile,

Every Little Dial Has a Meaning

WITH a dashboard containing as many instruments as are carried by a trans-Atlantic airplane, a small runabout made its appearance at Southport, England, recently. The woman motorist who drives the car has the assistance—or hindrance!—of thirty dials, clocks, and buttons, not to mention a strange assortment of mirrors, and other "gadgets."

The owner claims to be the world's champion buyer of auto accessories, and asserts that she can still pilot the car in spite of them!



She likes to know how the wheels are going 'round. But the question is, can she look at the right dial at the right time?

he removed the rear wheels and roped the machine in the bow of a twenty-six-foot motor boat. The swift current of the mountain stream made the passage a risky undertaking, but it was completed without accident.

Colored Telephone Poles to Liven Landscape

BRIGHTENING up the landscape with colored telephone poles is a suggestion recently made before engineers attending a telephone association conference in Chicago. One expert reported that his company had perfected a new wood preservative which triples the life of the poles and can be made in a variety of colors. Telephone poles, he said, could be colored to harmonize with the landscape or to brighten barren spots.

Doctor Makes 7,000-Mile Call by Radio

A DOCTOR, 7,000 miles from a patient, diagnosed the case over the radio recently. A woman suffering from a dangerous malady in Buenos Aires, Argentina, was put in communication with a specialist in Berlin, Germany, over a test short wave apparatus. After a conversation lasting twenty minutes, during which each could hear the other perfectly, the doctor was able to diagnose the case and to cable the prescription.

During the same week, a lock expert, in Idaho, was called on the telephone by an employee of an office in Oregon who had lost the combination to a large safe. The employee placed the telephone receiver close to the door of the safe and the distant expert, listening to the almost imperceptible sounds of falling tumblers in the safe door, directed her movements. In less than five minutes the door was open.



Tin Can Filling Station for Cigarette Lighters

FROM an empty tin can, you can make a filling station for vest pocket cigarette lighters by screwing on a newly devised combination metal tube, cap, and rubber bulb in place of the regular cap on the can.

The can holds sufficient gasoline to fill many lighters and, the makers say, forms a handy and economical means of keeping a vest pocket lighter replenished. The bulb is designed to have a capacity just sufficient for the ordinary lighter. Thus one squeeze fills the tank to the top without making it overflow.

Colds Blamed on Lack of Proteins in Diet

FREDERICK HOELZEL, of the University of Chicago, announces a theory, backed up by experiment, that susceptibility to colds is largely a matter of diet. Persons who eat too much sugar and starch, as most people do, and vegetarians and others who live on a low protein diet, are far more likely to "take cold," he says, than those whose food is high in protein content. This tallies with reports of Arctic explorers that colds are unknown among the Eskimos whose diet consists entirely of meat.

The explanation of the Hoelzel theory is believed to lie in some undetermined relation between the amount of fluid in the body tissues and their sensitiveness. Starches and sugar tend to store up water in the tissues. When this intake of water is lowered the sensitiveness of the tissues is also lessened, so that a cool breeze or exposure to dampness does not so readily affect the system. This theory would account for the fact that fat persons, as a rule, are more susceptible to colds than thin ones.

Tin Foil Amazingly Thin

THE tin foil wrapped around chocolate, tobacco, or cigarettes is thick compared to the foil used in radio condensers, which measures 4,350 sheets to the inch!

The thinnest foil provides 14,500 square inches from one pound of metal. Tin and lead foil are said to have been invented by the Chinese centuries ago, by hammering bars of metal. Today they are made by automatic machinery.

Did Man's Legs Develop Before His Head?

AN EXHAUSTIVE study recently completed by Dr. Wilhelm Gieseler, of the University of Munich, Germany, tends to show that the pedal extremities of man's remotest ancestor developed into human legs sooner than his skull evolved into a human head.

The two most-disputed examples of human or near-human remains so far discovered—the bones of the Pithecanthropus or ape-man of Java and the Broken-Hill Man of South Africa—are so primitive, especially the skulls, that many anatomists deny them human rank.

But Dr. Gieseler is of the firm opinion that the Pithecanthropus was decidedly human. This conviction he bases upon the fact that his eye sockets are manlike rather than apelike, although he admits that the skull is low.

And the thigh bones of both Pithecanthropus and Broken-Hill Man, according to Dr. Gieseler, tell a still more eloquent story. These bones, he says, are entirely unlike those of apes, but closely resemble those of modern man. This leaves the question up in the air, for, while Dr. Gieseler contends that his findings show that man climbed the evolutionary ladder literally feet first, scientists of the opposite school declare that the disputed thigh bones may not belong to the "low brow" skulls at all.



Tiny Dynamo Operates New Batteryless Flashlight

A TWIST of the wrist supplies power for a new flashlight. Turning the handle winds a spring that operates a tiny dynamo and produces current for a two-and-a-half-volt light.

This lilliputian electric light plant is said to furnish light as long as the spring is kept wound. One complete winding is said to supply light for two and a half minutes. While slightly larger than the ordinary flashlight, the invention weighs only two and three quarters pounds.

Experiments with flashlights without batteries were made by the United States Army some time ago and reported in POPULAR SCIENCE MONTHLY. At the time, the Army was considering discarding batteries entirely.

New Sugar Discovered in Dahlia Juice

A NEW sugar has been discovered in the juice of dahlia tubers by the U. S. Bureau of Standards, it was announced the other day.

In experiments to find out the structure of inulin, a starchlike substance found in dahlia juice, the sugar was discovered. Approximately ninety-two percent of the juice was resolved into the already known sugar, called levulose or fructose, but the remaining eight percent was a mystery. In further tests, the strange substance was reduced to crystalline form.



Stations Identified by This Radio Dial

THE latest radio dial is designed to flash the identification letters of each broadcasting station when its wave length is tuned in. Contact points are fitted in the dial at positions where the various stations are tuned in perfectly. Thereafter, each time one of the contacts is made a light flashes at the top of the dial and the letters of the station appear behind a lighted window. If wave lengths are changed, the contacts may be shifted.



Construction of new radio dial. By means of contact points, the broadcasting station's call letters are flashed in the window when station is tuned in.

Oceans on Frozen Planet May Be Liquid Air

THE sunward side of Mercury, nearest the sun of all planets in our solar system, may reach a temperature of nearly 800 degrees Fahrenheit, a heat sufficient to melt lead, zinc, or tin and to keep all water on the planet's surface permanently in gas form, like the air on earth, according to Dr. William F. Meyer, of the University of California.

If Mercury were inhabited, liquid water to the population would be a rarity, obtainable only by means of complicated apparatus, as is liquid air on earth.

On the other hand, says Dr. Meyer, the outermost planets of the solar system suffer from equally extreme cold. Uranus, next to the last on our system's outer rim, probably experiences an average temperature of about 300 degrees F. below zero. This is close to the temperature of liquid air. If Uranus has an ocean, the scientist assumes that it must consist of that material. Volcanos on Uranus might spout seawater melted from frozen rocks, as earthly lava consists of melted earth rocks.

"Rheumatics" a Real Storm Warning

ELDERLY people who say they can feel the approach of a storm or bad weather because their rheumatic pains increase, have been laughed at a good deal by the younger generation, but now physicians declare the oldsters are right.

At a recent convention of the Central Society for Clinical Research, in Chicago, a trio of distinguished doctors announced that observations over a number of years had shown that there exists, indeed, a close relation between storms, rain, and rheumatism. In ninety percent of the cases under observation, the patients were affected adversely by the approach of unfavorable weather.

Holder for Pipe Cleaners

THE smoker is provided with a new accessory in a holder for pipe cleaners which enables him to keep them within



In this novel decorative holder pipe cleaners are kept always handy and in good condition.

arm's reach on a table and prevents them from becoming dirty or bent out of shape. To lend attractiveness, designs are painted on the sides of the holders.

Lizard Hypnotized!

A CURIOUS animal of the Southwest, the blue-bellied lizard, has been proved susceptible to hypnotism. Edwin D. McKee, of the educational staff of the Grand Canyon National Park, has discovered that by keeping his eyes focused on those of the lizard as he approaches the elusive animal, it will remain tense and still and can be pinned to the ground with a quick dart of the hand.



Women Drivers' Car Signal Now—No Excuse!

PROTECTION for the dress sleeves and arms of women motorists, when they have to signal stops and turns on a rainy day, is afforded by a gauntlet of rubberized fabric just devised.

The gauntlet slips on the left arm, reaching above the elbow. It buckles snugly about the wrist to keep raindrops from running down the arm. When not in use, the fabric can be folded into a tight roll that occupies little space.

If Brain Size Counted, the Whale Would Be Smart

NEW substantiation of the theory that intelligence does not depend on the apparent size or weight of the brain, but rather upon its convolutions, was offered recently by a German scientist who, after years of investigation, announced that the whale, never distinguished for its brain power, possesses the largest brain of any mammal.

The record for brain-weight was established by a whale boasting some 247 ounces of gray matter! If brain volume had any influence on intelligence, it is apparent what an intellectual giant the whale would be when it is considered that the average brain of man seldom exceeds fifty ounces in weight!



Novel Lamp Cord Holds Cigarette Lighter

AN ELECTRIC lamp cord suspending a heating element from which the smoker can light his cigar or cigarette is the latest novelty for the living room. The lighter comes in a variety of colors to match the twisted silk-covered wire cord and so has the appearance of a tassel at the end of the cord.

Pressing a button turns on the electric current for the heating element. Another switch, located higher on the cord, governs the lighting of the lamp.

The device is installed by simply unscrewing the electric light bulb, screwing in a special socket, and replacing the bulb.

A New Kind of Mosquito! This Makes 141

ANYONE who, in sultry summer nights, has had his patience tried by a twenty-five-minute hunt for a mosquito, will admire the persistence of C. H. Bath, sanitary inspector at the Panama Canal, who has captured a new species of this pestiferous family that had eluded experts during a chase lasting twenty-five years!

The reason for the unending hunt of the sleep disturbers by United States health officials is the fact that some of them are breeders of malaria. The new capture, however, did not prove to belong to a variety of this kind. It was added to a series of 140 species which have already been listed.

World's Greatest Gas Line

ACROSS rivers and through mountain canyons, from Amarillo, Texas, to Denver, Colorado, what is said to be the largest high-pressure gas line in the world was completed recently at the record rate of almost two miles a day. This 575-mile line, carrying natural gas from the Amarillo fields to consumers in Denver and Pueblo, Colo., was in operation just 193 days after work was begun.

Decorative Metal Sawing

You Can Master the Use of Jeweler's Saw Blades While Making an Attractive Brass Teapot Stand

By EDWARD THATCHER, *Noted Teacher of Metal Work*

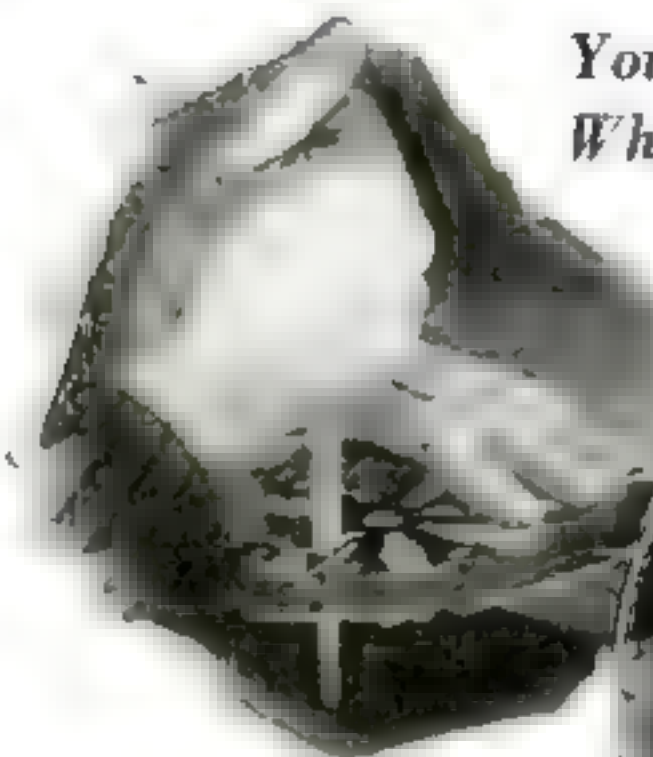


Fig. 2. The edges are smoothed with needle files and larger half round and crowing files.



SAWING is one of the most important operations to master in decorative metal work. While the heavier and larger pieces, such as hinges and hardware, may be cut out more readily with chisels as explained last month, the smaller pieces and intricate pierced openings in large pieces are usually cut with a jeweler's saw blade.

When the sawing is neatly done, little finishing is needed, it is sufficient to round over the cut edges neatly with files and emery cloth before the final polishing.

Those interested in model making or in radio construction will find a knowledge of sawing particularly useful. With proper saws an experienced worker can cut sheet metal up to $\frac{3}{8}$ in. in thickness, but the beginner should start with thinner metal, say No. 18 gage.

You must have a good saw frame either of the jeweler's or the coping saw type. If a coping saw frame is to be used, it should have two vise-like clamps to hold jeweler's saw blades, which have straight ends. Ordinary coping saw blades will not, of course, do for metal. Be sure to get the best saw blades you can and do not worry if you break a number of them while learning to saw. Buy a dozen or two at the beginning, later on you can save money by buying them by the gross.

You will also need a bench pin or sawing board (Fig. 1). Dimensioned drawings for two types of bench pins were given in a previous article of this series (December, 1927, issue, page 80). In its simplest form it is a piece of hard poplar, maple, beech, or birch, $\frac{3}{4}$ by 4 by 8 in., screwed to the top of the bench so as to project over the edge $4\frac{1}{4}$ in. The wedge-shaped slot in the projecting end is 2 in.



Fig. 1. The sawing is done on a wooden bench pin which has a triangular opening.

deep and $\frac{3}{8}$ in. wide at the open end. Attach it to the bench with flathead screws in countersunk holes.

Before you start sawing, be sure that the sheet metal is perfectly flat and also bright and clean. Scrubbing it with powdered pumice stone and water usually will put it in good shape and give it a slightly roughened surface to receive the marks of the carbon paper used for transferring a design to it.

Draw the design on stiff drawing paper, full size. Place a piece of new carbon paper face down on the metal, lay the drawing on this, and trace over the design to transfer it to the metal. Large thumb tacks may be used to fasten the

metal to a drawing board; then the carbon and drawing papers, which must be larger than the metal, can be secured over it with other tacks driven into the wood. The carbon lines left on the metal would become blurred in handling, so go over them with a steel scribing point and scratch them in distinctly.

Sometimes the surface of the metal is painted with Chinese white water color, which comes in tubes, to make a good surface for receiving the carbon paper marks. Some workers glue the

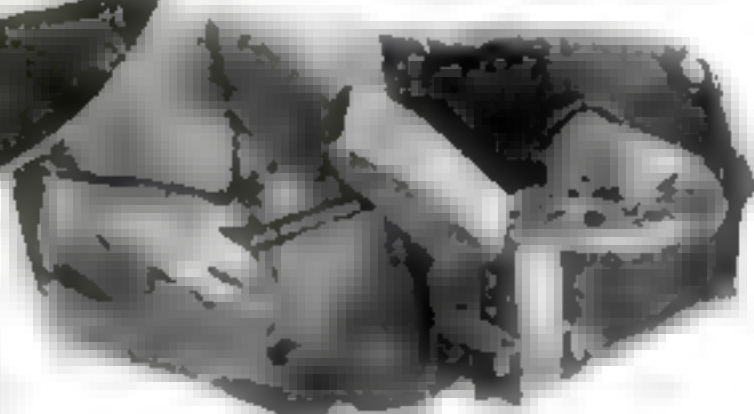


Fig. 3. The edges of the teapot stand are turned over with a mallet on a clean-cut block of wood held in the vise.

design directly on the metal with shellac, but I have never liked this method.

When a hammered surface is desired on the work, make the hammer marks on the metal before sawing.

If you have done no sawing, try some experimental cuts in a piece of flat No. 18 gage copper. A No. 4 blade will be satisfactory for this. Generally speaking, the thinner the metal, the finer the teeth of the saw should be. Jeweler's saw blades are numbered from Nos. B/0 to 12, the last being very coarse. You will have to learn by experience the best blade to use for each job.

Be sure that the blade is set in the frame with the teeth pointing down toward the handle. The blade should be held so taut that it will sound like a banjo string when picked.

Hold the metal firmly down on the bench pin with the fingers of the left hand as in Fig. 1. Do not press the saw against the metal with much force, use only sufficient pressure to make the blade cut easily. Beginners are likely to press too hard with the result that the blade binds and breaks or runs off the line.

Usually it is better to tilt the frame slightly forward and down toward the work except when sawing around sharp curves or turning a sharp angle. At such times the saw

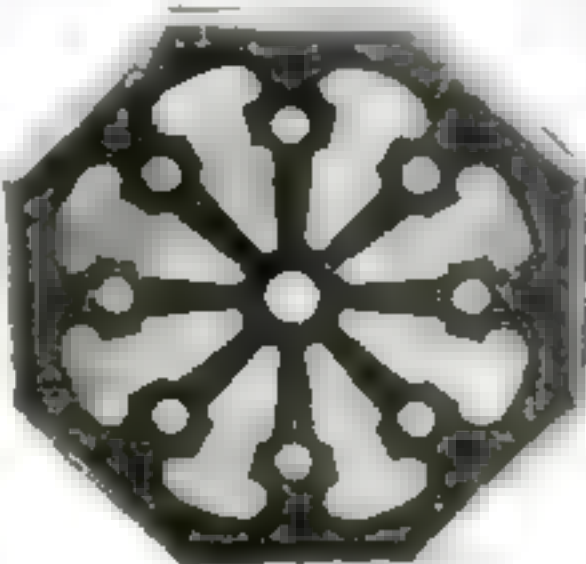


Fig. 4. Teapot stand made by Mr. Thatcher to illustrate the principles of sawing thin metal.

(Continued on page 126)

Ping-Pong Table Folds into Screen

*Although of Tournament Size,
It Can Be Stored in Small Space*

By CHARLES A. KING



IN THE present popular revival of interest in ping-pong, many of those who have fallen under the spell of its furious fun have asked themselves the question: "How can I build myself a good, firm, large table which will not be cumbersome or unsightly when folded up?"

The latest answer to this question is the table illustrated in Fig. 1. It becomes, when folded up, a four-leaf screen. It can be transformed from a table into a screen and back again by one person. Although all the parts of the table are contained within the screen, there is nothing bulky or unsightly about it when it is set up in a corner of the room where only the face side of it can be seen. Either the dark green playing surface can be left exposed as the face of the screen, or a decorative covering of figured chintz or other fabric can be fastened with tape or thumb tacks to the four standing leaves.

It is true, of course, that a large dining room table may be turned into a ping-pong board, but it is usually too small for a real game. The standard size for a home ping-pong table is 4 by 8 ft.; the tournament table is always 5 by 9 ft. and allows a much better game to be played.

If a dining room table or other large, substantial table is available, the problem of making a ping-pong table is obviously much simplified. It is necessary to make only the folding top, which can be stood up out of the way to serve as a screen when not in use. In addition, two pieces of $\frac{3}{4}$ in. thick board 9 ft. long will be needed to place on the table—or, if necessary, on two small tables—for supporting the folding game board.

If you wish to complete the table, you can, of course, provide detachable legs very easily and stand them away in a cupboard when the table is not in use. It is better, however, to go to the extra work required to make the legs

Fig. 1. This substantial ping-pong table can be transformed, top and all, into a screen.



self-contained as illustrated. Then they can be folded into the back or underside of the table top as shown in Fig. 2. The long rails, which come apart in the middle, are placed in the back recesses of the middle sections. All are held in place by springs.

The playing board may be made of $\frac{3}{4}$ -in. plywood, which is often used in making commercial tables, but this gives an unwieldy top unless a permanent table is desired. Instead, the top of our table is made of $\frac{3}{4}$ - or $\frac{1}{2}$ -in. plywood reinforced by $\frac{3}{4}$ by 2 in. strips around the edges and across the middle. The use of pressed wood will still further decrease both weight and expense. It is a light, strong,

stiff artificial board of warm brown color, its close grained, smooth surfaced texture make it peculiarly suitable for this purpose. However, almost any of the various pulp fiber boards on the market will be satisfactory and will cost and weigh less than plywood.

In making the board, first cut the four sections 27 by 40 in. See that each corner is perfectly square. If the pieces are cut from the nearest stock size, 32 in. by 8 ft., there will be considerable waste, which may be reduced if pieces 32 in. by 10 ft. can be obtained. If the latter are cut exactly in the center with a thin, fine saw, the only waste will be a 5-in. strip from the edge of each.

From seven pieces $\frac{3}{4}$ by 2 in. by 10 ft. of whitewood or other semihardwood, miller the reinforcements around the underside of each section. Plane their inside edges carefully, glue each piece as shown in Fig. 3, turn the board over, and drive 1-in. No. 15 brads slantingly through the top, setting them just below the surface. Before fastening (Continued on page 111)

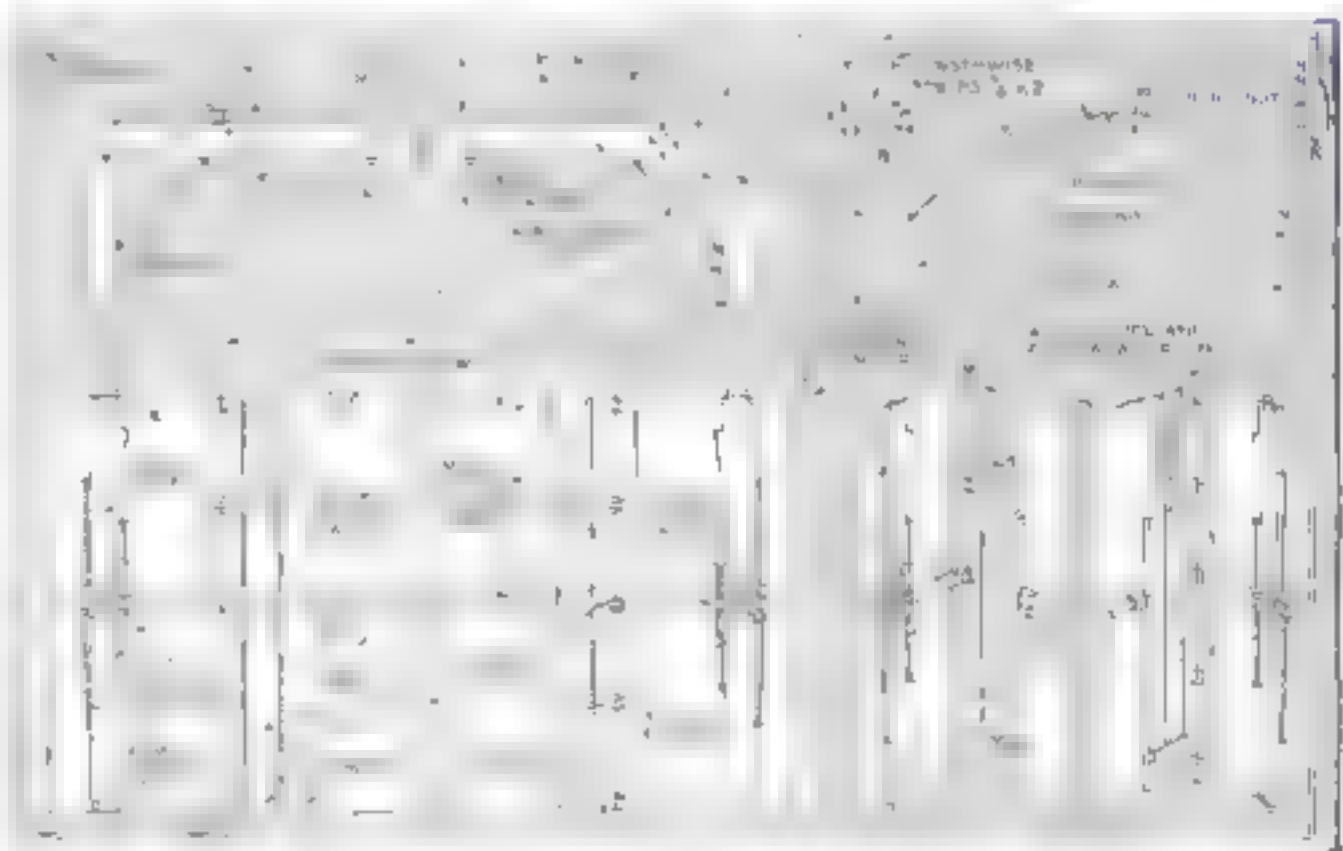


Fig. 2. Side and end views of the table: the underside of the top with the legs folded and the side rails stored away; and a drawing to show the rest of the screen, although ordinarily this side of it will be hidden.

Controlling a Model Railway

A Simple Way to Install a Central Switchboard from Which to Govern All Train Movements—Changing Voltage on Grades

By
FREDERICK D.
RYDER, JR.

JUST as it is necessary to plan the track layout of a model electric railway before you start building, so it is wise to make a preliminary study of the type of electrical control system you wish to install.

The ideal control system would be one that would permit you to sit in front of the control panel and perform all the operations of running the trains without leaving that position. And that degree of control can be obtained easily with the equipment now available.

Automatic reversing electric locomotives, of course, are needed, as well as electrically operated switches. Your problem is, therefore, one of arranging the control panel so as to make it convenient to handle and to install the wiring.

The location, size, and construction of the panel is governed by the size of the system and the position in which the control panel must be located. If the track layout is placed on a shelf or bench, the panel can be installed most simply by fastening it edgewise to the bench like an apron. A piece of plywood can be used.

The control panel of the elaborate and unusually complete model railway shown in Fig. 1 is a good example of this type of construction.



Fig. 1. Apron-type control panel used by James A. Baber, of Dorset, Conn., for operating his exceptionally well arranged model railway.

For track layouts placed on the floor, a simple design for a control panel is shown in Fig. 3. Cheap yellow pine siding is used to make it, with a piece of plywood for the surface where the switches and control buttons are mounted. As shown in Fig. 3 the top is hinged at the bottom edge to facilitate wiring.

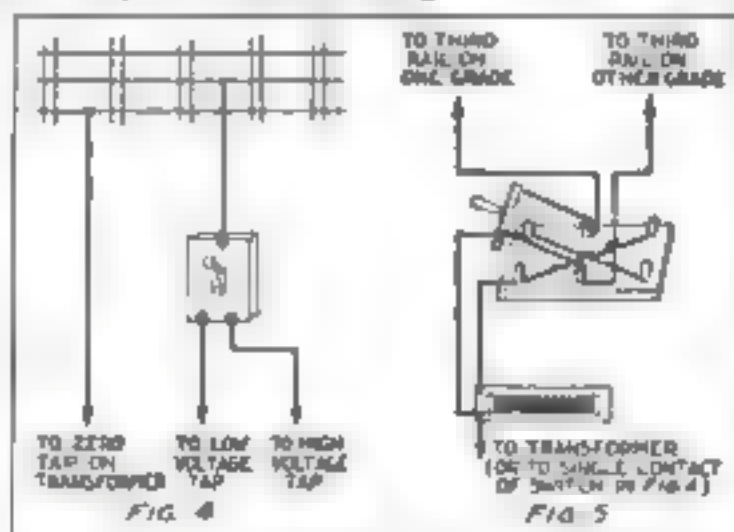


Fig. 4 (at left above). Quick acting voltage switch. Fig. 5 (at right). Switch for controlling power on grades.

A study of the electrical control as worked out on this particular unit will give you an idea of how to arrange a panel that will be suitable for your own system.

The top and second row of buttons are used to control the electrically operated switches in an interlocking arrangement that will be explained further along in this article. The buttons in the third row are connected to the sidings in the terminals. Push-button control of the sidings is desirable because it forces you to keep your finger on the button while a train is being operated on a siding and prevents accidents caused when a train rushes into a siding, crashing into a bumper or, perhaps, wrecking part of the station. These are standard half-inch doorbell push buttons obtainable in any electrical supply store.



The fourth row consists of small toggle switches such as are sold to radio set builders. Push-pull switches would do just as well as the toggle type. Each of these switches controls the current flow to a different part of the main line so that the current can be cut off from different sections of the main line and one train stopped at these points without stopping any other trains that may happen to be

running on other parts of the track. This method of sectional control was described in detail in articles in the December, 1925, issue of POPULAR SCIENCE MONTHLY, page 72, and the January, 1926, issue, page 80.

The two knobs are rheostats of the heavy-duty type. They should be capable of carrying at least $2\frac{1}{4}$ amperes of current. One controls the current to all sections of the terminal, and the other controls the current to all parts of the main line except the grades. This makes it possible to control a locomotive engaged in switching operations in the terminal without affecting trains running on the main line.

A double-pole double-throw knife switch between the rheostat knobs controls the current to the grades. Whatever goes up eventually must come down again, so if you have an up-grade in your track layout there must also be a down-grade to get back to the original level. Considerably more voltage is needed to drive the locomotives up the grade than is required on the level, and on the down-grade the voltage must be reduced to prevent the

(Continued on page 120)

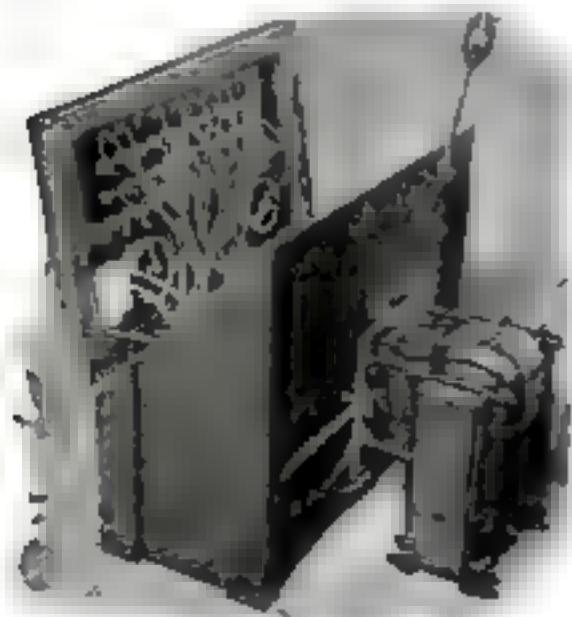


Fig. 2. Desk type of control panel as seen from rear, with panel raised to show connections.



Fig. 3. Front of the panel shown in Fig. 1. It gives complete control of all train operations.

Turning Rings of Wood

How to Make Napkin, Tie, and Towel Holders, and Round Picture Frames

By HERMAN HJORTH



A fascinating field for experiment is offered the amateur craftsman in turning rings.

This is turned partly between centers and partly on the faceplate.

NOW that motorized home workshop machines and small wood turning lathes are in use in so many homes and wood turning is becoming so popular a hobby, there is a demand for designs and projects that are a step in advance of candlesticks and other elementary articles with which beginners are at first content.

Readers have indicated that they are eager to try something requiring more skill. A fascinating project is therefore suggested—the turning of a solid ring of wood. This requires no additional tools or equipment. It represents an advance in the line of faceplate work discussed in the October and November, 1928, issues of POPULAR SCIENCE MONTHLY.

An example of ring turning is the napkin holder illustrated in Figs. 1 and 2.

If it is desired to turn two napkin rings, cut a piece of wood at least $\frac{1}{4}$ in. thicker and wider than the finished outside diameter of the ring and about 8 in. longer than the combined length of two rings. For two rings of the dimensions indicated in Fig. 1 the rough stock should be $2\frac{1}{4}$ by $2\frac{1}{4}$ by 8 in.

Square one end of the piece carefully with the sides, an operation which may be done conveniently by sawing the stock in a miter box. Locate the center by drawing diagonals and bore a $\frac{1}{2}$ -in. hole about $\frac{1}{2}$ in. deep with a gimlet or twist bit. Fasten the piece to a screw chuck, which is simply a small faceplate with a single heavy screw in the center.

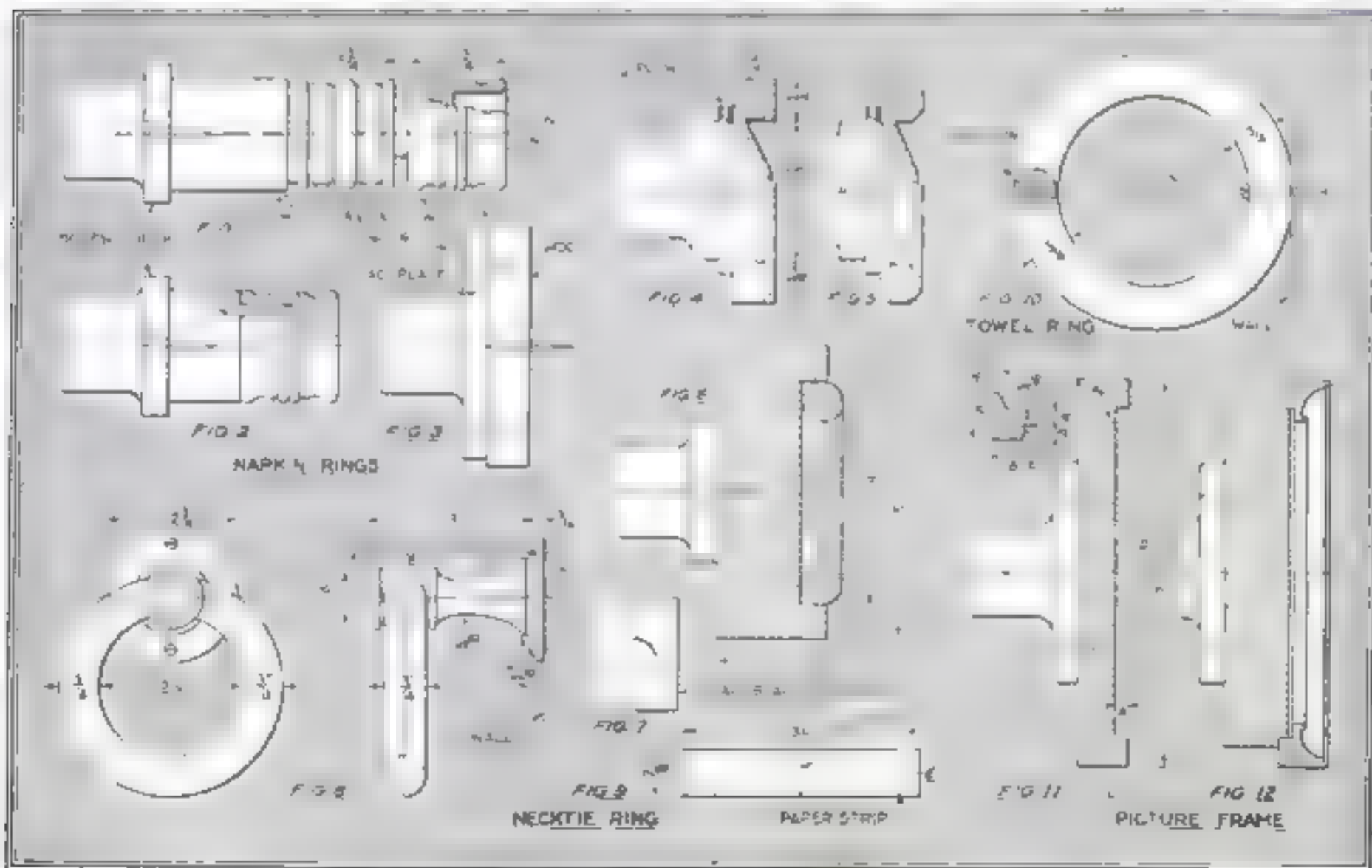
If a screw chuck is not a part of the lathe equipment, an ordinary faceplate may be used. Screw a piece of wood to

the faceplate and turn a circular disk as explained in the October, 1928, issue, page 112. Mark the center on the disk while it is revolving in the lathe and bore a $\frac{1}{2}$ -in. hole, countersinking it on the side which is against the faceplate. Insert a heavy flat head screw of the proper length (depending upon the thickness of the disk) and fasten the piece to be turned firmly to the disk as in Fig. 3.

The dead center is now run against the free end of the $2\frac{1}{4}$ -by- $2\frac{1}{4}$ -by-8-in. piece, which is rounded off and smoothed in the usual manner. The napkin rings are then laid out, turned, and sanded as explained in previous articles.

When the outside shape of the rings has been formed, the dead center is moved out of the way and the tool rest placed close to the end of the piece and at right angles to the lathe bed. Mark the diameter of the $1\frac{1}{2}$ -in. hole with a pair of dividers (use the second method described on page 132 of the Oct., 1928, issue) and start the boring of the hole with a very sharp round-nose chisel. Begin in the center and gradually work out towards the

(Continued on page 115)



Any wood turner who masters these four simple projects will be able to do a large variety of similar work. A close grained wood such as

birch, maple, ashogany, or walnut should be used, or for more ornamental effects, a combination of contrasting woods glued in layers.

Luxuries to Add to the Home

Magical New Comforts and Labor-Saving Inventions to Help Bring the Old-Fashioned Dwelling Up-to-Date

By MILTON G. STURGISS

"HELEN, I saw a wonderful house today," I lit my pipe, hitched up a chair to a comfortable place near the fire, and started on a "selling talk" I had prepared for my wife.

"Went out to look at that 'model house' in Meadowville today. Talk about your 1929 styles! I didn't realize how out-of-date our place is getting until I saw the new one. It's the last word—even to shoe-shining cabinets that fold in the wall and colored tile bathrooms!"

"I suppose you want to go right out and buy it," observed Helen.

"I'd like to," I admitted.

"So would I. But you know mighty well we can't afford it. What's the matter with making our own place over, a little at a time? Let's make our own synthetic 1929 home."

That was the start of the argument. The finish was that the next Saturday we made a tour of the manufacturers' show windows to see what ways there were to bring our old-fashioned dwelling up-to-date.

That tour was a revelation. Although it was bewildering to see in a single day all the new labor-saving devices and finishes that can be put in one's home, certain dominant ideas stood out.

FOR instance, we were surprised how many ugly things are tucked completely out of sight in the 1929 home. You may enter a living room and look in vain for radiators—yet the room is comfortably heated. New steam radiators, extremely narrow, will hide within the wall under a window. They are only three and a half inches thick, yet, because of their many-finned design, they radiate as much heat as others twice the size. Warm air emerges through an inconspicuous grill.

The telephone and its monstrous directories had cluttered our living room for years. No wonder we were impressed to find, in one showroom, a handsome little telephone nook built into the wall. A telephone occupies its center shelf. Below is a recess for directories; above, a carved door hides the unbecoming bell box.

A glance at a model kitchen showed the absence of the old unsightly garbage pail. Instead, there is a trapdoor in the wall. Scraps thrown into it disappear down a chute, to be destroyed in an incinerator in the basement.

Bulky objects have a way of vanishing



For casement windows—a "ventilating" pane of bulging glass with slitters beneath.

"HOW can I make my home more comfortable and more convenient?" The author answers this question asked by thousands of American home owners, with the story of a trip which he and his wife made to the showrooms of manufacturers. You probably will be as amazed as he was at the variety of luxuries that are available. True, many of the conveniences he tells about in this article are more costly than so-called standard equipment, but you must determine, as he did, which of them are worth enough to you to justify the extra cost. After all, the value of a piece of equipment must be in its use to the individual householder. The Editor.



A space-saving radiator, only three and a half inches thick, hides within the wall beneath a window ledge. Its many-finned design is claimed to afford abundant radiating surface.

in 1929, we learned. A white enameled panel in a tiled bathroom wall folded out when I pulled a small handle, and revealed itself as a shoe-shining cabinet. A surprising built-in cupboard only an inch or two thick, on a kitchen wall, revealed a folding utility table and an ironing board when Helen opened the door.

WE WERE delighted with many other built-in improvements. A recess in the wall, lined with asbestos-coated steel, offers a handy receptacle for the electric iron when not in use. A ventilated aluminum door allows the iron to cool quickly and safely. One ingenious invention is a cabinet set into the kitchen door, used for receiving delivered packages when you are not at home. The grocery boy inserts his bundles through an outer door; returning home, you unlatch the inner one and remove the packages, which, meanwhile, have been protected from rain and stray animals.

One of Helen's pet dislikes is to clean out the ashes in an open fireplace. That messy job takes a lot of the fun out of a log fire. But on our tour we ran across a self-cleaning hearth. To empty ashes you need only grasp an inconspicuous lever, unlock it with half a turn, and pull. A trapdoor beneath the hearth swings open. Down a chute go the ashes. Meanwhile, through a clever arrangement of levers and cams, a curved plate covers the opening so that dust cannot fly up.

To us, the modern home was a museum of built-in conveniences. What else?

A pageant of color! Spectral-hued pots and pans are only a start. We wouldn't believe, until we saw with our own eyes, that we could buy a heating boiler in sky blue or scarlet. In the bathroom, where staid white has so long held sway, many-hued tiles, alternating sometimes with striking black, are now newly popular.

AS VARIED as their colors are the materials in which these tiles are offered. One of the novelties is a so-called Belgian tile that is flexible, and can be bent around corners. It is coated upon zinc, and may be applied to any smooth plastered wall.

A modern luxury for the bath that excited our envy was a glassed-in shower compartment trimmed in gleaming chromium plate—built up from the bathtub's rim nearly to the ceiling. Splash away to

your heart's content, and not a drop can spatter on the floor. A grille at the top of the glass door provides ventilation.

Built into the wall, a new bathroom heater contains three objects that look like electric light bulbs. To my surprise, when I pressed a switch, a pervading warm glow issued. The bulbs are especially designed for heating, although they contain filaments like ordinary lamps.

HAVING examined the new "fixtures" of the modern house, we turned next to interior wall finishes.

Once you could take it for granted that living room walls would be covered with wall paper. Now they are paneled, in fascinating new materials. Or, if you prefer, they are covered with a textured, stucco-like finish applied with a brush and molded and colored to suit any style of architecture.

For wood paneling, among the novelties, there is a new fireproof wood, chemically treated. It looks like ordinary wood, and retains its finish as well, yet its makers claim that it cannot burn. It is used for wainscoting, trim, flooring, doors, or molding.

Another paneling is a "woodless wood," made of Portland cement and asbestos. Only when you rap the panels, or beams of the same material, does a stone-like response betray the substitution.

A third is a grainless wood, made by shredding actual wood and then pressing it together again. Dense and tough, it is said to be proof against cracking and impervious to moisture.

Now, too, there is an amazing wall finish that transforms painted plaster walls and beams into wood. Even the grain of wood is imitated. The product is a thick liquid. A companion finish produces an effect of stone.

ALL the beauty of stone walls in Colonial, Spanish, or even modernistic style is possible through new "plastic paints," giving a variety of textured finishes. These are powders, which are mixed with cold water and applied with a brush to the wall or ceiling after any wall paper has been removed. Then they are molded to the desired texture by manipulating the surface with a brush, whisk broom, comb, sponge, wad of

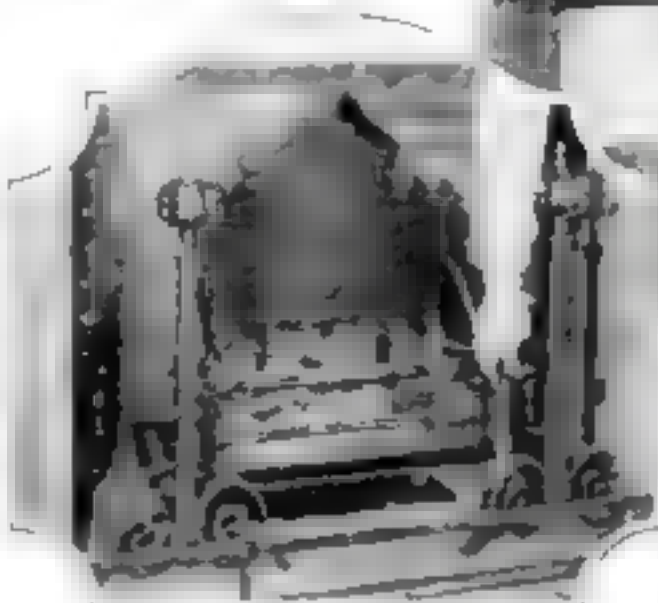
paper, or even the palm of your hand! They harden to a stone-like finish. Water or oil colors are used to tint them; should you tire of a wall color after a few months, it can be removed with hot water and soap, and a new one applied. A glazed finish is a possible variation.

For those who still prefer the old styles, another novelty is "wall paper, colored." It is hung like wall paper, and if soiled after months of wear it may be wiped clean with a damp cloth.

Curtain windows have lately come into vogue for



A glass-enclosed shower bath—almost as the latest luxury in the up-to-date home. Note the modern bathroom floor and walls tiled.



Pull this inconspicuous lever, and a trapdoor in the hearth dumps the ashes down a chute to the cellar.

modern interiors. But there is a temptation to keep them shut when a gale is raging outside, even if the air in the room is becoming unbearably stuffy. Now it is possible to admit the air, but keep out the blustering gale, by inserting one or two new "ventilating panes" of bulging glass instead of the standard flat ones. Openings in them let in more or less air, as desired, through control shutters. The hooded shape keeps rain out.

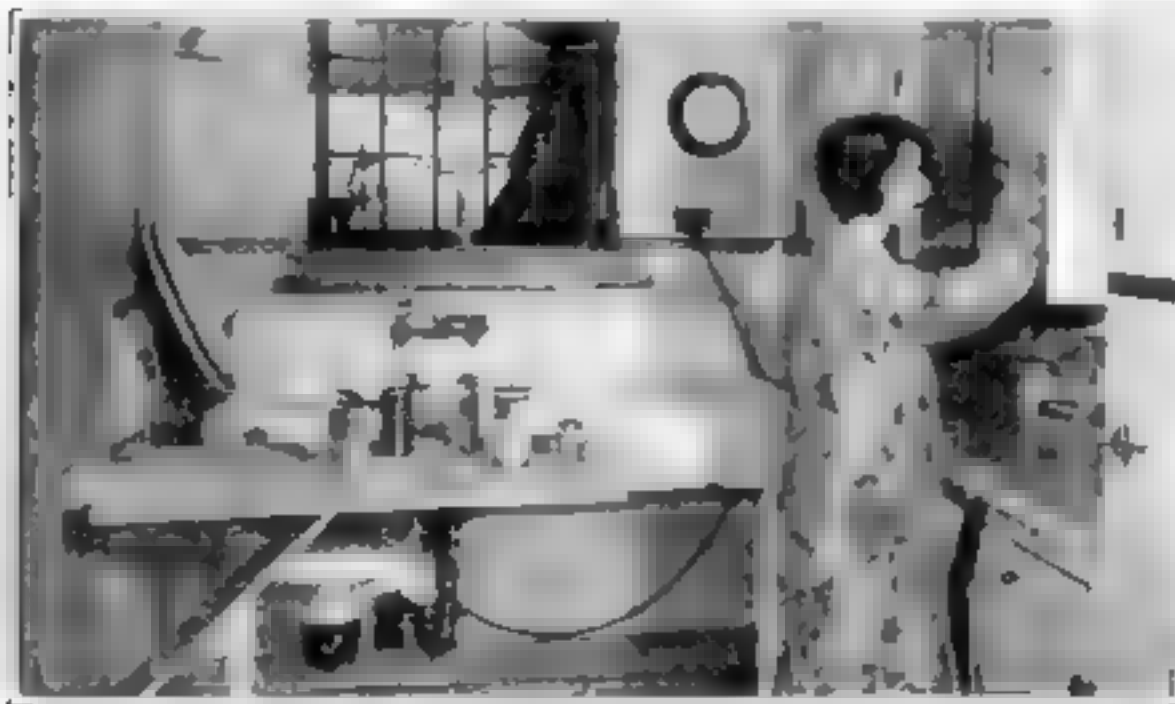
New windows, some in handsome steel sashes, swing inward for easy cleaning. An innovation in window screens is one that is wound on a roller like a shade.

out cracking, have attractive textures and tints; and face bricks now offer a many-hued, colorful wall of purple and rose, red and chocolate brown hues.

THERE are almost as many different types of roofs as houses to put them on. Asbestos shingles, durable and fireproof, are offered for roofs and siding. They are applied directly over the old surface and provide a pleasing variety of color possibilities. Copper shingles are obtainable in strips that are light in weight and give a roof of exceptional permanence. An attractive French tile for roofing is made of concrete. An interesting novelty, where economy is paramount, is a "print roofing" made of asphalt-saturated rag felt, that comes in rolls. Applied directly on a new roof, or over old shingles, its fabric carries a shingle pattern.

A house that is warm in winter and cool in summer is possible through the use of one of many heat-insulating materials. One is a composition board manufactured from cane fiber, used under the plaster for inside walls and ceilings. It supplies insulation back of brick, wood, or stucco exteriors. In homes already built, it sheathes the walls of attic and basement. Plastic paint for wall interiors may be applied directly over it; or decorative panels may be created with gold bronze and stenciled Japan colors, applied with the aid of glue size and varnish.

Among other coal-savers are cork boards, quilts of felt or other substances used as lining in (Continued on page 100)



A corner of the 1929 kitchen. The photograph shows, left to right: Utility table that folds into wall; incinerator chest; electric sink with built-in dishwasher; wall thermometer; handy cabinet.

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Railroads, Airplanes, and Speed

RECENTLY published reports of the latest and largest locomotive in the world, built for the Northern Pacific Railroad, stress the fact that engine and tender are half the length of a city block, weigh a million pounds, can pull a loaded train two miles long on a level track, and consume twenty tons of coal and 14,400 gallons of water an hour. But nothing is said of its speed.

Indirectly that omission expresses one reason why this country is being criss-crossed with air lines. Speed, especially in transportation and communication, is the great discovery of the age, and for more than two decades our railroads have made no progress toward greater speed.

Twenty-five years ago a man could board the Twentieth Century Limited in Chicago and be in New York just as quickly as he can today. In fact, the time now is two hours longer than it was when the run was made in eighteen hours. Other famous trains still run on time schedules established years ago.

And it isn't because a railroad train can't go faster. The Empire State Express, running between New York and Buffalo on the fastest schedule in this country averages only 48.7 miles an hour. Yet that same train covered a mile in 1893 at the rate of 113 miles an hour.

So long as our railroads are content to live in the past, resting on honors already won, the swift winged airplane will continue to prosper because it answers the modern demand for speed—and more speed. Nothing can stand still and survive.

John Early, Leper

WRITE down, among the decisive episodes of history, the strange story of John Early, leper. It is a story not only of a brilliant victory of medicine over the dreaded scourge of centuries, but of a dramatic battle to save a man from himself.

John Early, a North Carolina mountaineer, became notorious for his many escapes from leper colonies and for his armed resistance to confinement and medical treatment. One day about five years ago, the national capital was startled to learn that he had escaped from the National Leper Home at Carville, La., and had registered in a Washington hotel. Pursued, he armed himself with a rifle, hid in his mountain home, and for months resisted capture. But at last, in May, 1927, he gave himself up to Federal officers and was taken back to the leper home. There he submitted to treatment.

Now comes the announcement from the United States Public Health Service that John Early has recovered. His

terrible disease has been arrested by a new method of treatment by injections of chaulmoogra oil. He is scarred but free.

Thanks to heroes and martyrs of medical research, the tragic cry, "Unclean!" is passing from the earth. Its passing renews hope that remaining scourges, such as cancer, soon may be overcome.

The Double Duty of Science

BENJAMIN FRANKLIN once observed that while his attention was concentrated on attempting to eradicate one of his bad habits, another would creep in unawares. Every now and then the same thing happens to the human race as a whole.

While people's thoughts are occupied with the problem of crossing the ocean by air, the tragedy of the *Vestris* brings us to a shocked realization that much still has to be done before we can honestly say that crossing the oceans—even by ships—is absolutely safe.

And while the sinking of the *Vestris* may or may not have been preventable, the fact remains that such a catastrophe is a blow in the face to our vaunted scientific progress. As pointed out on page 30 of this issue, the business of science is to render safer our present modes of travel, as well as to perfect new ones!

War on the "Common Cold"

MAN'S most mysterious and most expensive ailment is what is foolishly called a "common cold." Two good hard common colds are the average annual lot of everyone in America. And a recent survey showed that colds are responsible for forty-seven percent of the time lost in industry.

Science has not yet located definitely either the cause or its cure. But like every disease about which medical knowledge is scarce, theories are plentiful. The demonstrated facts seem to be that colds are caused by germs; that these germs are most virulent in the early stages, and that colds are most prevalent at certain seasons of the year. Nothing more.

However, studies just begun at Johns Hopkins University may result in determining reasons and remedies for the cold, an achievement from which everyone of us would benefit. This would save hundreds of millions a year in wages and—more important, would reduce the number of deaths from pneumonia, diphtheria and other destructive diseases. Nature built the body machine. Science teaches us how to keep it well oiled—to keep it free from disease.

Marvels We Take for Granted

MORE than 80,000 electric signs flash on at dusk in New York City. The bulbs in these signs number more than a million. Still, nobody wonders whether they will function when the switch is thrown. Their reliability is taken for granted. Yet, it was only in 1848 that the first electric sign in the city caused a seven-day sensation. And eight years earlier, passengers on an Atlantic steamship sent the company a note of congratulation on the working of electric lights on board!

It is the uncertain that commands our attention. The biggest thing on earth is the ocean tide. The greatest power-plant in our heavens is the sun. They function like clockwork. We are sure of them. And we give them little thought. Similarly with inventions, and the products of man's ingenuity. We marvel awhile then turn to the next wonder. When their reliability becomes assured, we take them for granted.

They Are Saying—

"WATER power in the future will be inadequate to meet the demands for electrical power."—Thomas A. Edison.

"I felt infinitely more concerned for my safety in crossing Fifth Avenue, New York, than I ever felt in the jungle."—Arthur Vernay, big game hunter.

"Our American women are in better physical condition than our men. Women do not wear too many clothes."—Dr. Ephraim R. Mulford, President of the Medical Society of New Jersey.

"Coal, which costs less than \$3 a ton at the mine, should be turned into gas at the mine, furnishing the producer with \$15 worth of by-products per ton."—Dr. Arthur D. Little, famous chemist.



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What Feeds Gas to Your Car?

A Haughty Woman Driver Learns from Gus Why It Pays to Know How Fuel Supply Systems Work

By MARTIN BUNN

"**Y**OU the mechanic here, my man?"

A harsh, feminine voice rattled Gus Wilson's eardrums and brought his head around with a jerk.

"Yes m," he mildly replied to the bossy female whose car had coasted up behind the veteran auto mechanic.

"Well," she snapped, "I hope you're not as dumb as most auto mechanics. I know something about cars myself and I don't intend to be swindled. Can you fix this car or can't you?"

"What seems to be the matter?" Gus inquired, still mildly.

"It's your job to find that out," she replied pointedly.

Joe Clark, Gus Wilson's partner in the Model Garage, had strolled over to watch and the older man slyly winked at him as, without further remarks, he raised the hood of the car.

"Now don't try to tell me it's the vacuum tank," she warned Gus. "I took off the pipe and primed it with gasoline several times and that isn't the trouble."

"Primed the vacuum tank?" questioned Gus, puzzled.

"That's what I said," she snapped. "I took off that pipe right there." And she pointed to a round metal tank fastened to the side of the engine.

"I don't wonder that didn't do much good," Gus observed with a grin. "That tank, lady, is the oil filter. This car hasn't got any vacuum tank!"

"What!" she gasped, and her domineering attitude went down like a flat tire. "No vacuum tank? Why, the course I studied said that all cars had vacuum tanks."

"Not quite all," grinned Gus. "In Ford cars, both the old fixtures and the new ones, they stick the supply tank up high enough so the gas'll run downhill into the carburetor. It's called the gravity system. But there's at least three other ways of doing the job. Air pressure is one of 'em. Then there's a dinky little magnetic pump that draws juice from the battery to work it. And this boat and several other breeds use a new kind of a mechanical pump."

"**W**HY so many different systems?" the woman inquired interestedly. "I should think only one could be the best, so why use the others?"

"Differences of opinion is what makes horse trades, ma'am," Gus replied. "Each system has its good points and its bad. It looked for a while as though the

vacuum tank would win out. Nearly all cars had 'em. But better roads and faster driving brought out a bad feature. When you're sailing up a long, steep mountain road, or burning up the road on the level, the vacuum tank falls down on the job. It depends on the vacuum in the manifold to work, and when the throttle is nearly wide open there isn't any vacuum.

"The pressure system gets around that trouble, but it costs more to install, and there's always a chance for a leak in the pressure lines. The gravity system, though, can't go wrong unless somebody repeals the law of gravity!"

"If it's so perfect, why doesn't every car have it?" the woman inquired.

"**S**OME designers," explained Gus, "don't like the idea of putting the gas tank in the cowl back of the dash, and that's about the only place in a modern car where it will be high enough to feed right on the hills. It works out all right in light cars with small gasoline tanks, but a big car needs a bigger tank that takes lots of room, and when it's full there's a lot of weight up in the air instead of down near the road where it ought to be."

"What's the matter with the other two systems you mentioned?" she asked.

"Well," Gus replied, "the electric pump goes dead if something happens to the electric wiring, and the new mechanical pumps haven't been on the market

"Primed the vacuum tank?" Gus grinned. "That, lady, is the oil filter. This car has no vacuum tank."

long enough to be sure about what they do after years of service."

"Which system would you rather have on your own car?" the woman inquired.

"Any one of 'em," said Gus. "so long as it was installed right and put where it could be repaired easily."

"**B**UT you'd want to be able to recognize it, wouldn't you?" she smiled.

"That is kind of necessary," admitted Gus. "And there's another thing about automobiles you ought to know. Don't jump at conclusions. You made up your mind that something was wrong with the gasoline feed and you were bound you'd find that kind of trouble."

"What is wrong, anyhow?"

"Oh, I fixed that while we were talking," Gus grinned. "The high tension wire had snapped off at the coil. Now I'll drain the crank case to get rid of the gasoline you poured into the oil filter, and put in fresh oil."

She cordially thanked Gus and drove off. Joe then spoke up.

"Good work, Gus. Know who that was? That's Hank Preeble's widow. He left her a big trucking business over in Tupperville. She's got a lot of repair work she could throw our way. It sure pays to treat 'em right."

"Sometimes it's a tough job, though," grinned Gus. "I certainly wanted to tell that dame to go jump in the lake!"



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The Month's Best Auto Ideas

Handy Kinks That May Save You Trouble or Get You Out of It An Ingenious Opener for Garage Doors



Fig. 1. Incision in radiator, after the shell is removed, gives access to obstructing particles.

THE "neck of the bottle" in an automobile radiator is at the top of the cooling fins or tubes. Any foreign matter that floats around with the water always gets stuck at this point and the result is retarded circulation and a tendency for the motor to overheat.

Ordinary flushing will not remove serious obstructions. But you can get them out by the simple method shown in Fig. 1. Remove the radiator shell and with a sharp, strong knife make a curved incision. Then fold out the flap thus formed. Pick out the obstructions with a pointed instrument, push the flap back in place, and solder it. Radiators are made of thin sheet brass so this is easier than it looks.

A Tool Compartment Lock

A COMMON location for the tool compartment in the sedan or coach is under the front seat. Usually it is neces-

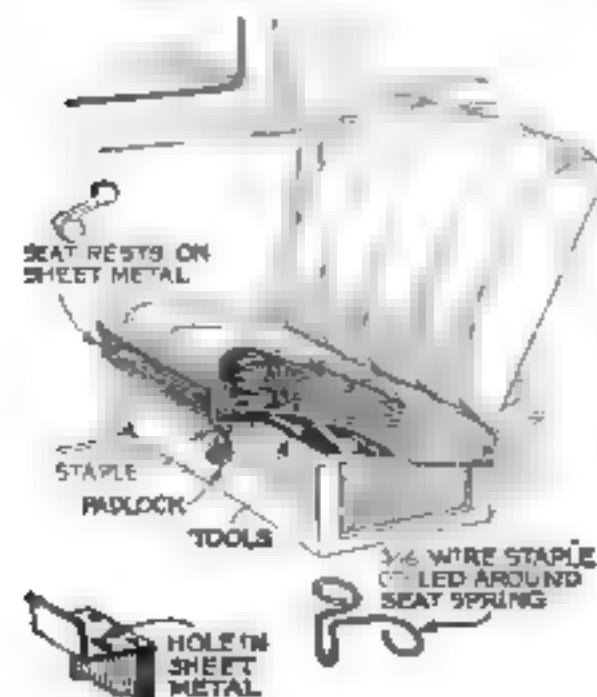


Fig. 2. By preventing lifting of the seat, this lock safeguards the contents of your tool compartment.

Ten Dollars for an Idea!

G. Solomon, of Puerto Plata, Santo Domingo, wins this month's ten-dollar prize for his suggestion of a garage door opening device (Fig. 3). Each month Popular Science Monthly awards \$10, in addition to regular space rates, for the best idea sent in for motorists. Other contributions used are paid for at the usual rates.

sary to raise the front of the seat cushion and pull it forward in order to lift it out to get at the tools.

You can fit a lock, as shown in Fig. 2, that will prevent lifting the front edge of the seat cushion and thus prevent the theft or unauthorized use of your tools when the car is stored in a public garage.

Both Doors Open At Once

FIGURE 3 shows a novel fitting for any double garage doors. It is designed so that when you open or shut the door at



Fig. 3. Side and top views of the ingenious device for making double doors open at the same time.

the left in the illustration, the other door will open or shut automatically. The material you need consists of a board of sufficient length, three bolts, a strong iron lunge, and wood screws.

As you open the door at the left, a connecting bar, pulled along with it, opens the door at the right by pulling on the end of the offset block. In closing, the thrust of the connecting bar closes the door at the right.

Blowing Starts Siphon

AN INGENIOUS way to siphon gas from the tank of your car is illustrated in Fig. 4. Insert one end of a rubber tube deep into the gas tank; the other into a container. Then, wrapping your fingers around the tube where it enters the tank so as to make as air-tight a connection as possible, blow into the tank. The pressure will force the gasoline out.

You may find that a tighter connection can be made by wrapping your pocket handkerchief around your fingers.]



Fig. 4. Blowing into the auto gas tank forces gasoline through a siphon tube into a container.

When the Battery Is Dead

IF THE battery is so low that the car won't start, even with the hand crank, a couple of flashlight batteries will do the trick. Fig. 5 shows how to connect them. Remove the ignition coil wire leading to the ignition switch, and replace it with a wire from one end of the two flashlight batteries connected in series (you must have at least four cells). Then connect the other end of the two batteries to the metal crank case.

Crank the motor, and when it starts, speed it up to send a charge through the storage battery. A few minutes' run will put enough charge in the battery so you can start the car again with the crank.

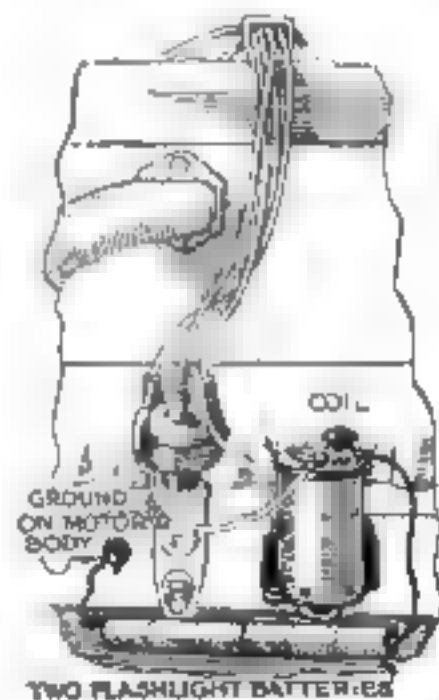
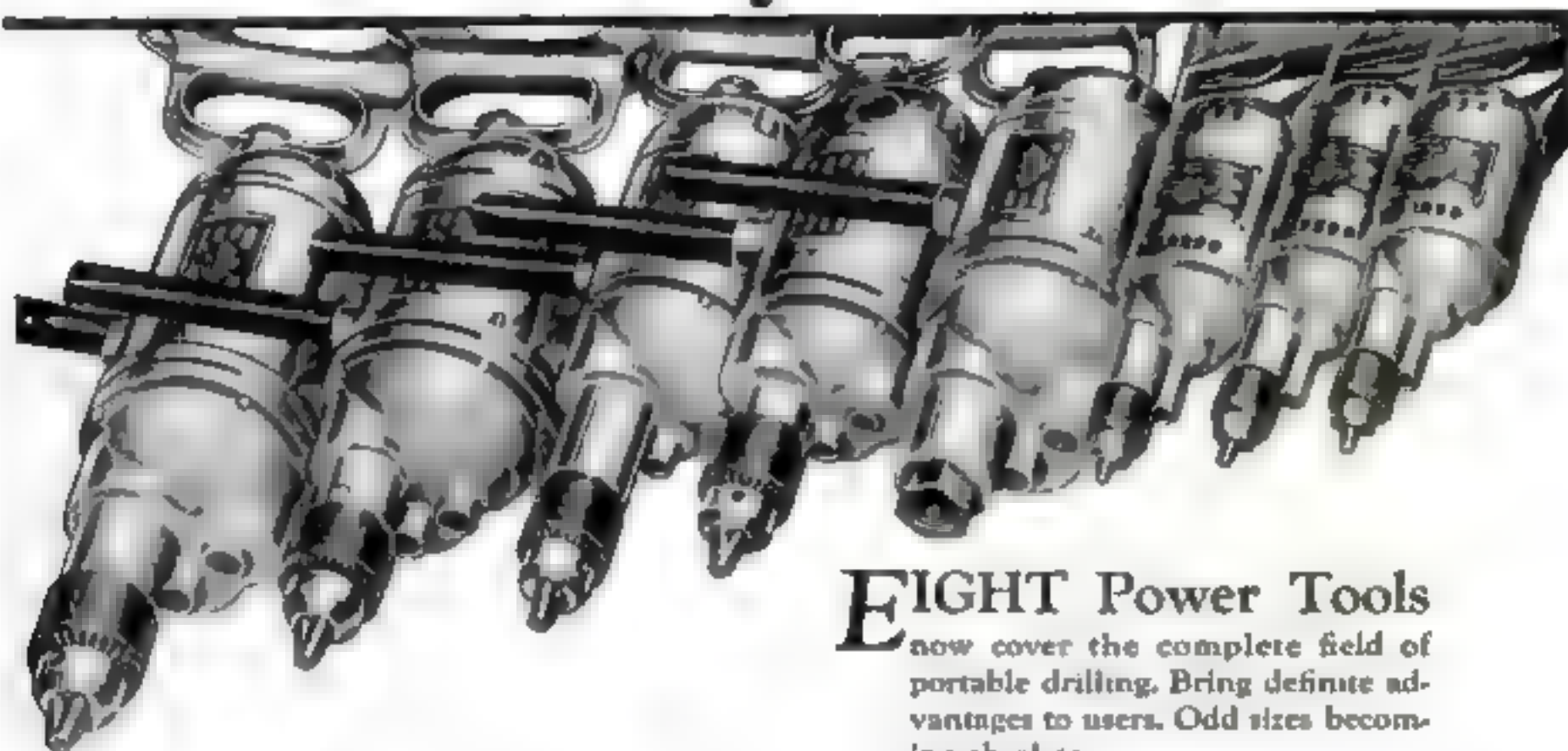


Fig. 5. How to wire two flashlight batteries to start the motor when storage battery is discharged.

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What a cigarette meant there

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and raw nerves fighting wearied muscles,
driving them on into that fearful unknown
beyond the wire. What man will ever for-
get the steadying solace of that last sweet
stolen smoke?

What a cigarette means here

Two years to go—
the slow "ageing" by which tobacco for Chester-
field loses all bite and harshness . . .

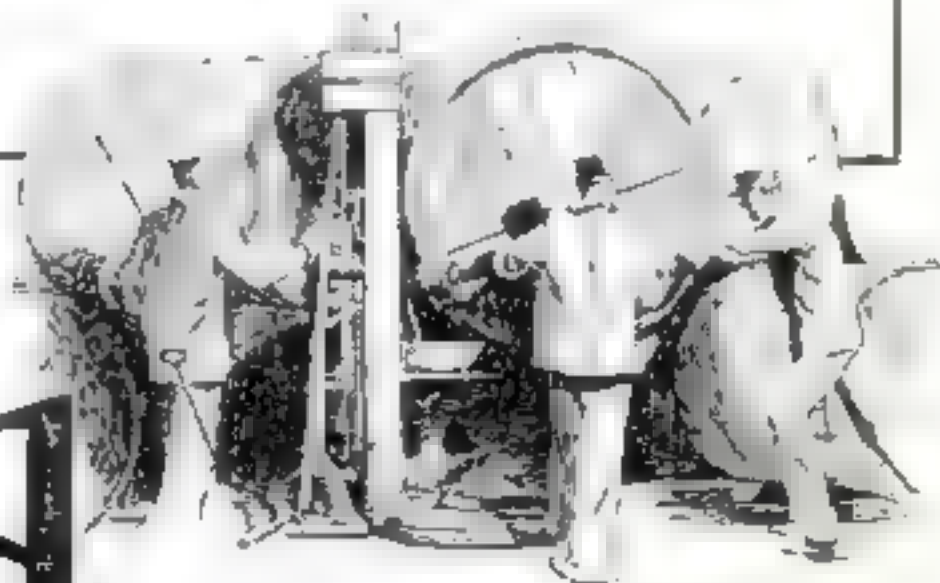
Mysterious, this chemistry of Nature! Endless
rows of great hogheads, stored away in darkness,
choice tobacco, tightly packed . . . just waiting.
And as if on signal, twice each year the leaf goes
through a natural "cure"—steeps in its own ex-
siccates, grows mild and sweet and mellow.

Selected leaf, costly patience, endless care—
that's what a cigarette means here. But right
there is exactly the reason why Chesterfield
means what it does to you!

Leggett & Myers Tobacco Co.

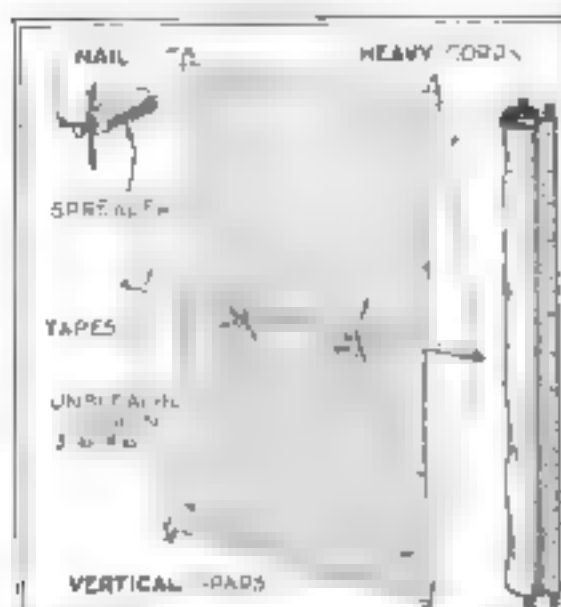
field

.... and yet **THEY SATISFY**

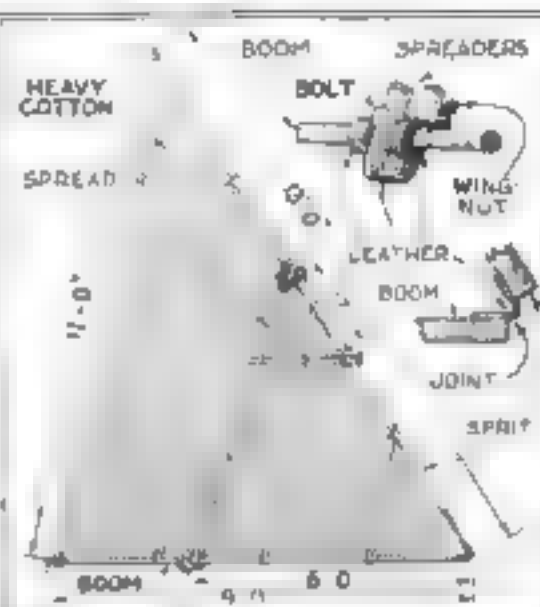
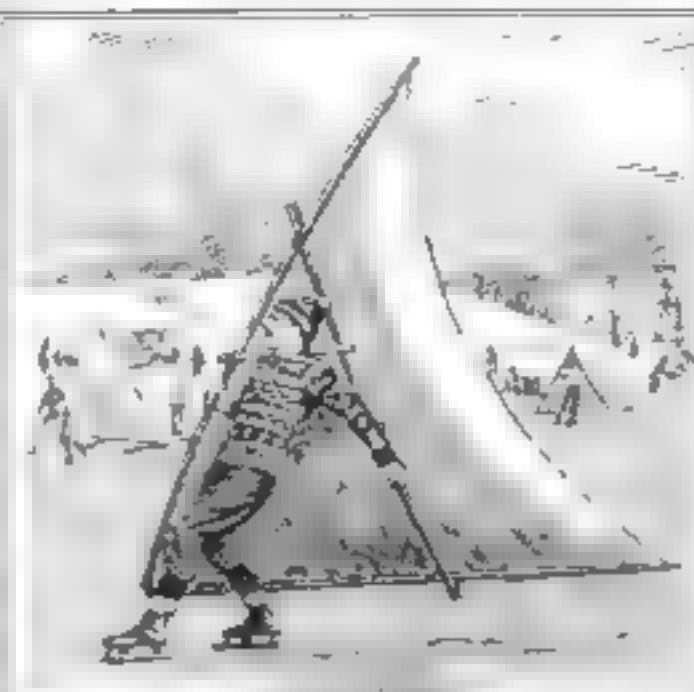


Millions of pounds of
choice tobacco from each
crop are stored away in
great warehouses to "age."

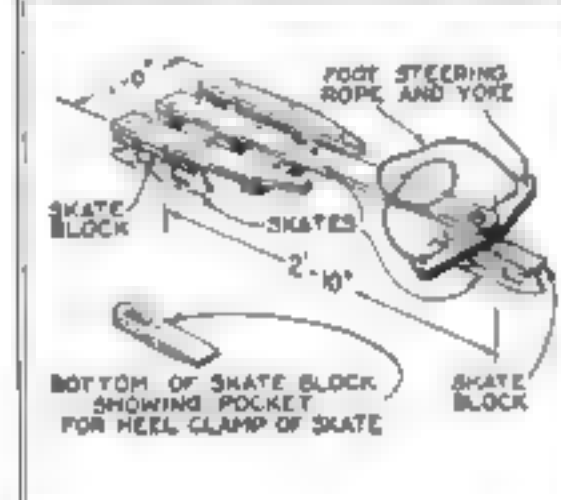
Now for Winter Sports!



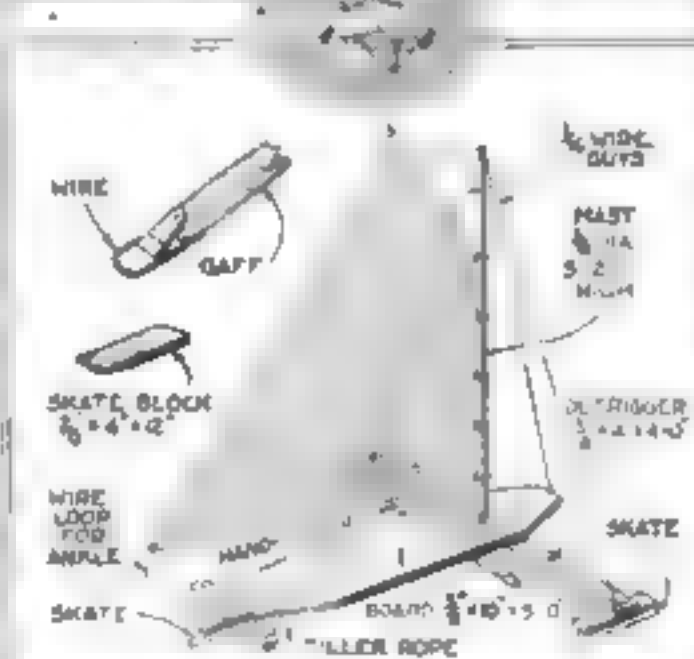
Simple type of square skate sail. Hold it behind you by the ends of the spreader.



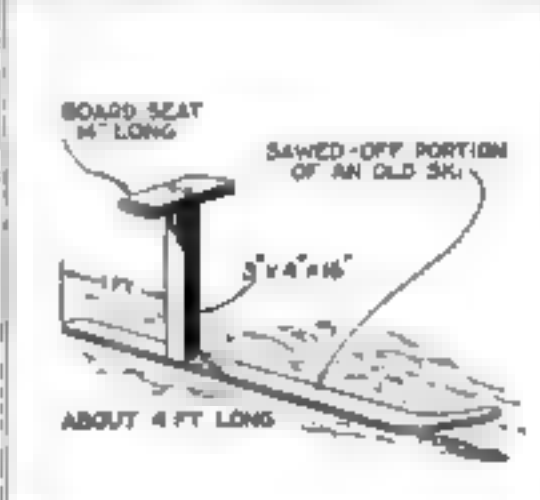
A skater with this type of triangular sail experiences the thrill of racing like the wind.



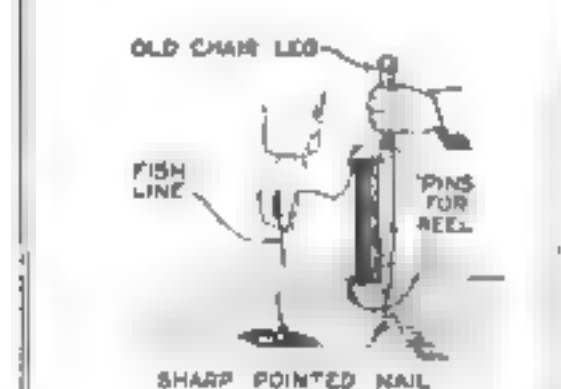
Steered with either hands or feet, this skate bob travels on ice or hard packed snow.



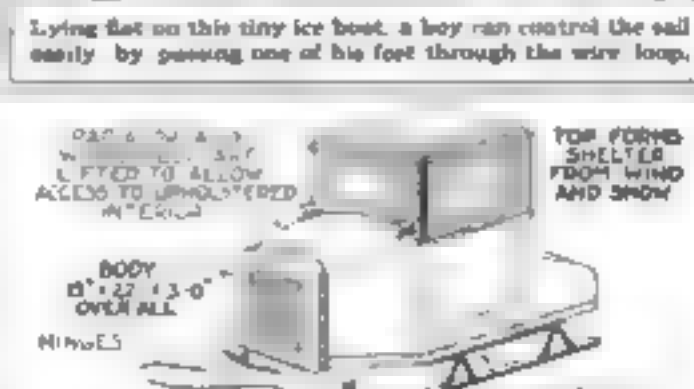
Lying flat on this tiny ice boat, a boy can control the sail easily by passing one of his feet through the wire loop.



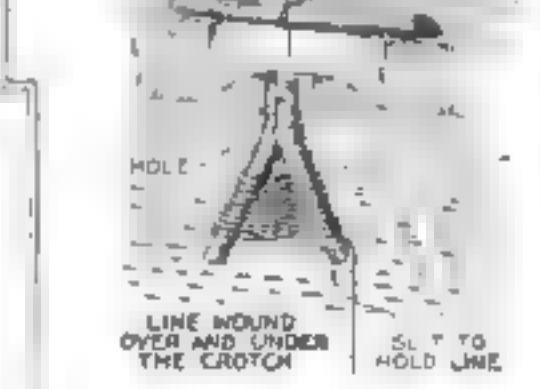
The front half of an old ski and two pieces of wood make this tricky, speedy coaster.



The instant the bobber dips, a fisher then can seize his line on this holder.



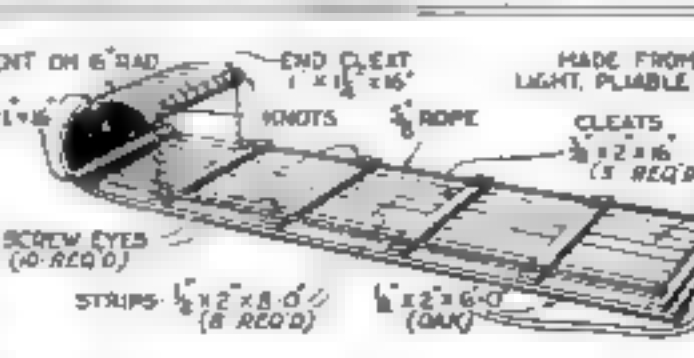
Auto sled to take the place of a baby carriage. The wood frame is covered with tin outside and upholstered inside.



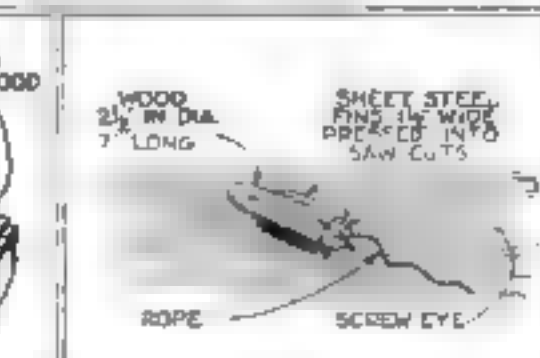
Set line for large game fish such as pike. It unwinds slowly and exhausts the fish.



A little charcoal or wood in this stove will warm a skater's chilled hands.



Homemade toboggan. The front end of the bottom strips are planed thin, steamed or boiled, and bent around a form.



Ice torpedo to be along on the end of a rope toward any suitable target.

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YOUR WORK in wood can be beautiful if you will let a Stanley Forty-Five Plane help you produce flutes, beads, reeds, rounded corners and other finishing touches.

This remarkable plane combines seven planes in one in a convenient and practical form. Furnished with a large number of cutters, it cuts rabbets, dados and fillisters; and also does a great deal of work which ordinarily must be done in a woodworking shop.

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Your hardware dealer can supply you with Stanley Plans and Books. If he does not have them, write us. The plans cost only 10 cents each, Books \$1.00. Address The Stanley Rule & Level Plant, New Britain, Conn.

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No. 8e—Dinner Gong
No. 9e—Bird Houses

No. 10e—Dog House
No. 11e—Book Stand
No. 12e—Smoking Cabinet
No. 13e—Kitchen Cabinet
No. 14e—Sewing Cabinet
No. 15e—Cedar Chest
No. 16e—End Table
No. 17e—Tea Wagon
No. 18e—Model Sailboat

No. 19e—Combination Sill and Row-Boat
No. 20e—Combination Kitchen Seat and Step Ladder
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No. 22e—Garden Trellises
No. 70e—Small Tool Chest
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STANLEY TOOLS

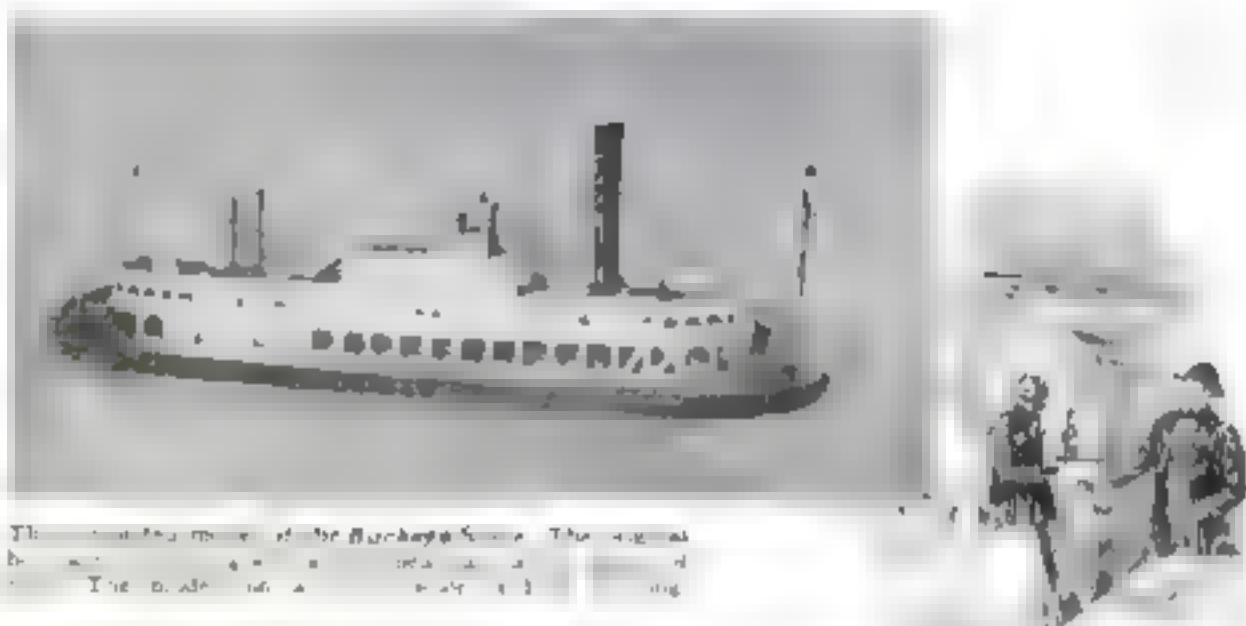
Building the "Buckeye State"

If you would like to construct a model of this famous old Mississippi River steamboat, you can begin now simply by sending for POPULAR SCIENCE MONTHLY Blueprints Nos. 94, 95, and 96, which contain complete full size drawings. Use the coupon on page 103. This is the fourth article of the series.

By

E. ARMITAGE McCANN

Master Mariner



The model of the 'Buckeye State'. The original is a full size drawing of the boat. The model is a scale of 1/4 inch to 1 foot.

THOSE readers who are building a model of the stern-wheel Mississippi steamboat *Buckeye State* now have the hull complete with two decks and the cabin house on it.

Whether one is especially interested in the Mississippi River or not, this model is an attractive one to make because the *Buckeye State* is typical of the only completely American craft with the exception of the Indian canoe. It represents a type of steamboat evolved to serve 14,000 miles of winding rivers, for the most part very shallow. Even as far back as 1847, according to statistics gathered by Frank L. Coca, there were 938 river boats with approximately 200,000 tonnage, which was more than the steam tonnage of Great Britain. Indeed, the history of Mississippi steamboating is extraordinary throughout.

We have now progressed in the construction to the point where the third or upper deck is shaped and plank marked. This deck must now have square holes cut in it for the ladders. The two forward holes are $\frac{3}{4}$ by $\frac{3}{4}$ in.; the after one is more nearly square. Now lay the deck

on a flat surface while doing other work.

Fix the two forward ladders in position with glue and by driving a pin point through the lowest step. Build safety rails around three sides of the openings.

DRILL $\frac{1}{4}$ in. holes for the forward struts of the hog chains (actually Main Chain No. 2) as shown in Blueprint No. 95 and on page 102 of the January issue. These holes should be $\frac{3}{4}$ in. from the edge of the deck at the positions shown. Bore down until the drill enters the lower deck. Drill a small hole for the chain or rod itself, and make another hole in line through the lower deck. Do not put the struts or chains in position yet.

Next place the struts supporting the extension of the cylinder beam to carry the wheel (see page 122). An upright post $\frac{1}{4}$ in. square goes through the boiler deck and is set into the cylinder beam. Forward of this there is a strut half that thickness, bolted to the top of the post and bolted to the inside of the beam. Aft there is a similar strut running from near the top of the post to the beam about $\frac{1}{4}$ in. inside of where the wheel bearing

will be, and a staff that is another from the top of the post to nearly the end of the beam. Fit the latter but do not place it in position until the wheel is fixed. The other members may be glued and nailed. These ought also to have bar chains, but I think they may be omitted on so small a model. No. 22 wire, painted black, is used for all chains.

The upper deck may now be placed in position. I fixed mine by driving some pin points into the cabin for it to rest on, with some more above to keep it down. The points need project only $\frac{1}{8}$ in. Brackets glued to the house

underneath would make a better job, but perhaps are more trouble on so small a model than they are worth.

For the two rails below the handrail of the main deck, cut $\frac{1}{4}$ in. wide strips of thin cardboard, such as three-ply Bristol board. Glue one side of these, clip one end in position, and stretch them along.

This and other similar clipping is most easily done with ordinary spring clothespins, the points of which can be sawed to various shapes.

Next to be made are the side rails between the two decks and above the upper deck, together with their stanchions. These may be entirely fashioned from wood, but thin cardboard will make the work infinitely easier and will look almost as well. I made one piece to surround the space between the decks and another for the upper handrail, but it would have been better to have made the two in one piece as shown in the drawing on page 122.

As before advised, use only the very best cardboard, such as artist's three-ply Bristol. To go all the way around would take a very long strip, so it can be in two pieces, from right aft to right forward, amidships. First stretch an oversized piece right around, holding it in position with glass-headed pins. Mark on it the underside of the boiler deck, to get the sheer; also mark the center of every other of the lower stanchions. Remove it and draw the pattern, noting that one of the upper posts comes over every second lower post.

THE openings at the after end will have to be a trifle larger than at the other to make them balance. Slots will have to be cut in the lower edges to pass over the stern struts.

With a sharp-pointed knife or chisel, cut out the openings very neatly, leaving no hurtled edges. Do this cutting on a piece of glass or another piece of cardboard.

The lower edge projects $\frac{1}{4}$ in. below the edge of the boiler deck and the upper edge is $\frac{1}{8}$ in. above the upper deck.

On the outside glue thin strips of cardboard along the (Continued on page 122)

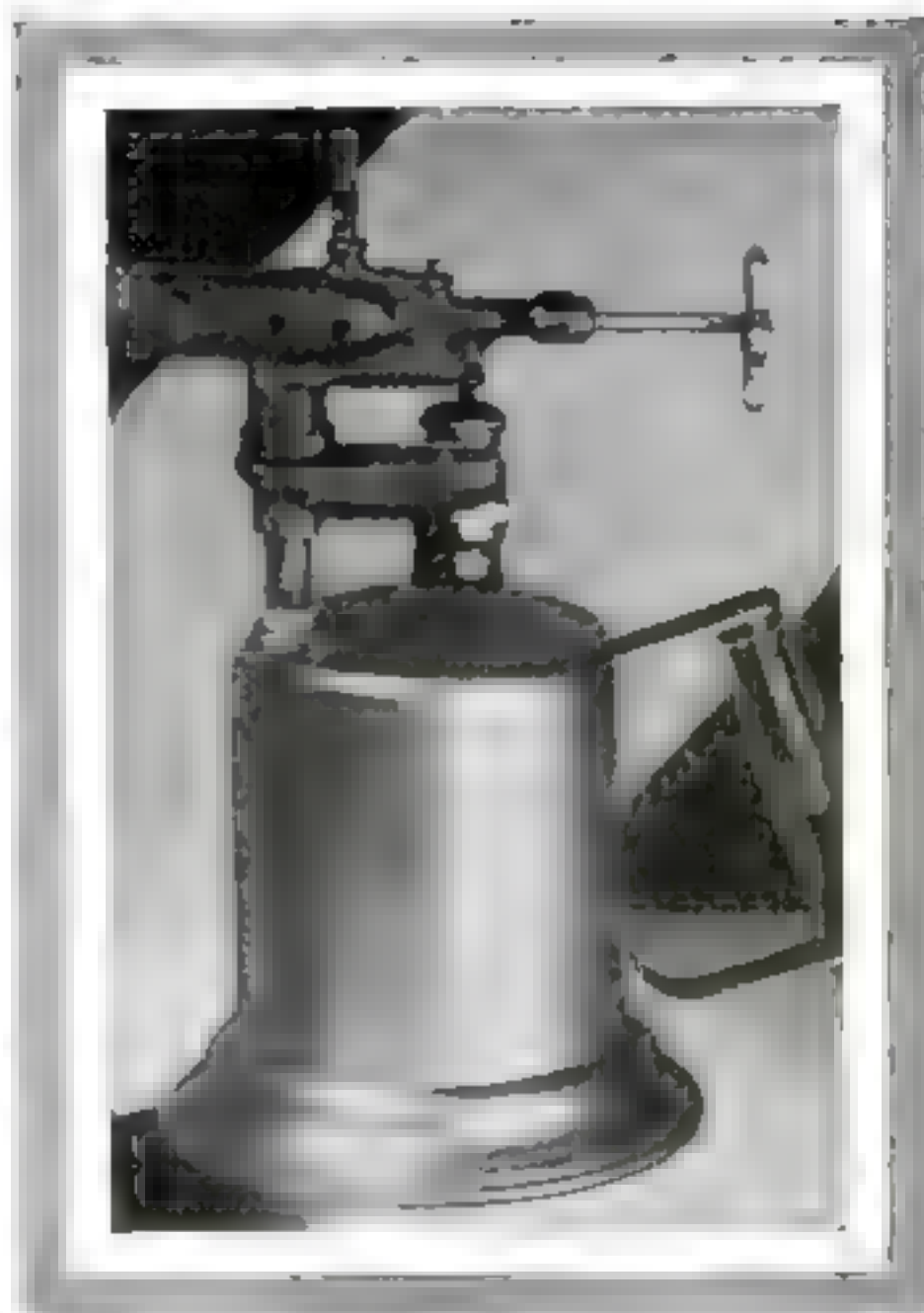


How the Bristol board rails are applied. Capt. McCann put them on in four sections, but time is saved by making them in two sections.

C & L 158

This blow-torch is especially made and priced for the man who likes to do odd jobs around the house, or to tinker with mechanical things. It will last a lifetime if it is not abused. The usual retail price is about five dollars. Most hardware, electrical and automobile accessory stores have it—or can get it for you quickly. Look for the gold-banded, red handle.

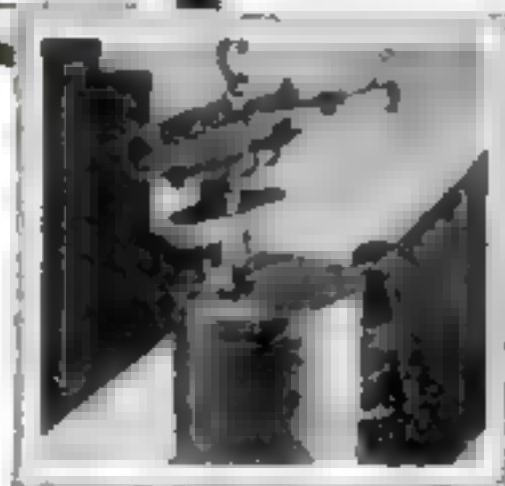
IS THE FEELING FOR FINE TOOLS IN YOUR BLOOD? •



DO YOU get a real kick when you pick up a good tool? One that makes working a pleasure? That makes you want to stick at the job? Well, be set to feel that way when you take up a Clayton & Lambert blow-torch.

In a Clayton & Lambert you buy all the exactness and pride that can be put into a blow-torch. You get materials that have proved their value by use. You obtain the result of 40 years' experiment and invention—exclusive Clayton & Lambert improvements. In construction and mechanism, Clayton & Lamberts are made with an eye for long, efficient service.

For instance—the vaporizing chamber has an exclusive vein system for quicker, hotter heat. That makes the torch function better and saves money



C & L 32

This is one of the most popular blow-torches we have ever made. It is more expensive than the 158 because it is made for much harder use. It is designed for the man who uses a blow-torch in his daily business and demands not only excellent performance but rugged ability to stand rough handling. 32 contains the most advanced, patented C & L blow-torch improvements.

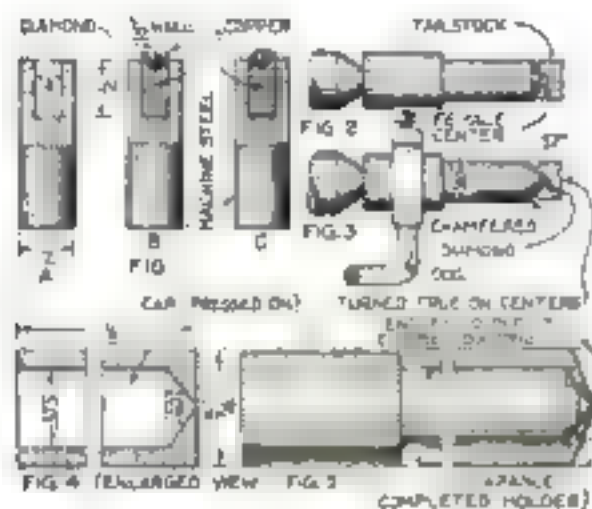
on your fuel bills. All fittings are built into the tank by a patented method that prevents their falling in or coming out. There's *absolutely no danger* of an explosion with a Clayton & Lambert torch. Even the most delicate part—the gas orifice—is fool-proof. In the No. 158 the orifice has a guard. The slightly higher priced No. 32 has a patented control valve so that you'll never ruin the torch by a careless twist of your wrist. And when you close the valve you automatically clean out the carbon.

The next time you're in a hardware or electrical store look for the blow-torch with a gold-banded, red handle. Be sure of the handle—it marks a Clayton & Lambert. Then you're getting the largest selling torch in the world.

CLAYTON & LAMBERT

MANUFACTURING COMPANY, Detroit, Mich.

Timesavers for Shop Men



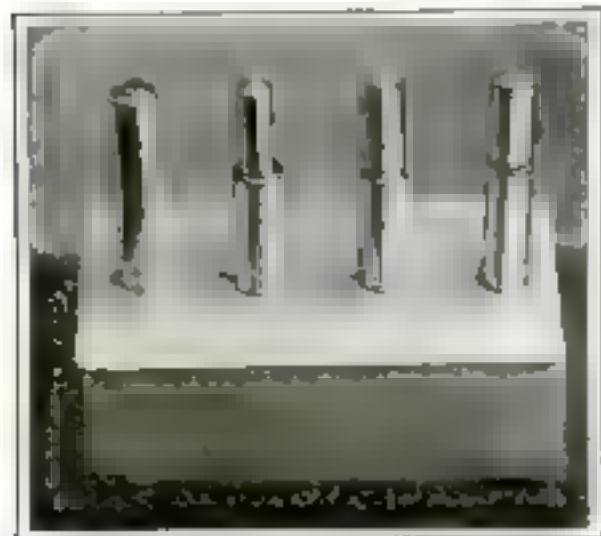
Steps in setting a black diamond in a holder for use in dressing grinding wheels accurately

WITH the increasing use of diamonds in machine shops, many men have become very familiar with their care and setting. Diamonds can be purchased either set or unset. If they are bought set, they usually have to be reset after a time, depending upon the quality of the diamonds and the service to which they are put.

The stones used for dressing grinding wheels are what are known as black diamonds. There are several grades, but it is usually economy to buy a good diamond, as it will give much more return for the money invested. Also, it is well to get a diamond large enough for the work, just as when buying a monkey wrench.

Most diamonds are brazed into a steel holder. While brazing has been used with apparently good results for many years, much attention has been given to other methods. One result of this study has been the use of metals other than brass that melt at relatively low temperatures. This has been carried so far in one instance as to make a setting that will soften and release the diamond should it reach 800 degrees F. in service. The method was devised to avoid damaging the diamond, yet if overheating in service is likely to damage the jewel, as experts maintain, why not heat it to 1800 or 1800 degrees in the setting also be detrimental?

This thought led to the development of the method of setting shown in the illustrations in this column. The diamond is



A mounted diamond and holders in three stages of completion. No brazing is required.



Old Bill Says—

WHEN you are forming a radius on the corners of an end mill or a side mill, use a fine grain wheel to get a smooth finish.

The average small shop generally has poor equipment for testing a lathe taper set-up. It is safest to take figures at both ends of the work. But don't use a file to get results!

Don't throw a piece of machinery steel into the tool steel scrap bin. If you do, some other mechanic, if not yourself, is likely to get into trouble.

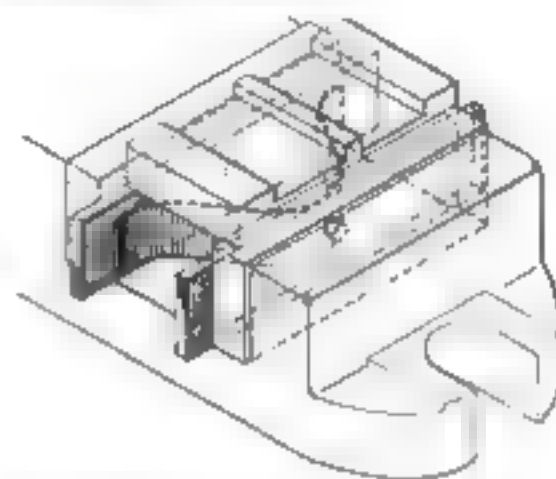
When a grinding wheel has a tendency to burn the work, cut notches $\frac{1}{8}$ in. deep with an old file at every inch of the circumference. This will help materially to cool the work.



held just as securely and is not heated in setting.

The first steps are shown in Fig. 1. A hole should be drilled about $\frac{1}{2}$ in. deep in the machine-steel diamond holder. This hole should be about $\frac{1}{8}$ in. larger than the diamond. Into the hole is driven a piece of copper rod, which is allowed to project $\frac{1}{8}$ in. A hole just large enough to fit the diamond is drilled into the end of the copper plug deep enough to receive the diamond so that the point is just flush with the end of the plug. Then the copper is carefully peened over the diamond with a small set. Of course, this peening must be gently done to avoid fracturing the stone. The point of the diamond should be kept in the center of the holder as nearly as possible.

The holder is next turned on the outside true with the diamond. This is done by centering the rear end of the holder, and running the diamond in a female center



This, springy spreader used to support parallel under flat work held in a vise.

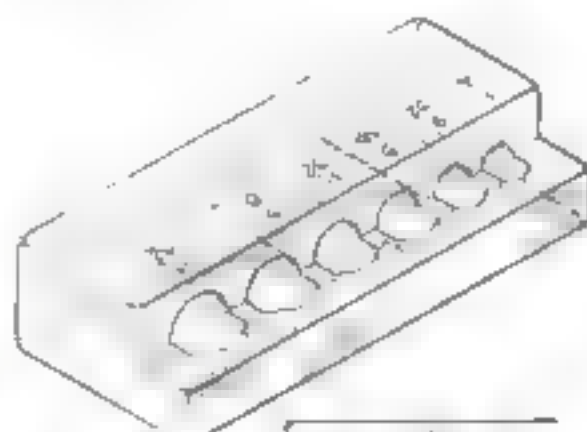
held in the tailstock of the lathe. The female center is made by drilling a small hole in a piece of $\frac{1}{4}$ -in. stock held in the chuck and allowing the diamond to true up the hole to fit itself (Fig. 2). A little emery and oil will assist.

Next, the end of the holder is chamfered to an angle of about 57 degrees, as shown in Fig. 3.

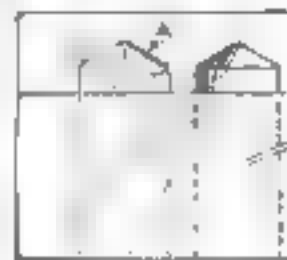
A cap is made from $\frac{1}{8}$ -in. stock and reamed to press over the turned portion of the holder as shown in Fig. 4. The bottom of this cap must be reamed with a reamer having an included angle of 60 degrees or slightly greater than the angle of the chamfered point. This is so that when the two are assembled the cap will bear on the point of the diamond only. A hole about half the diameter of the diamond is drilled through the end of the cap.

The cap is pressed on the holder and its end faced off as shown in Fig. 5 to expose the diamond. This completes the setting, which should take about one and a half hours, after the first trial.

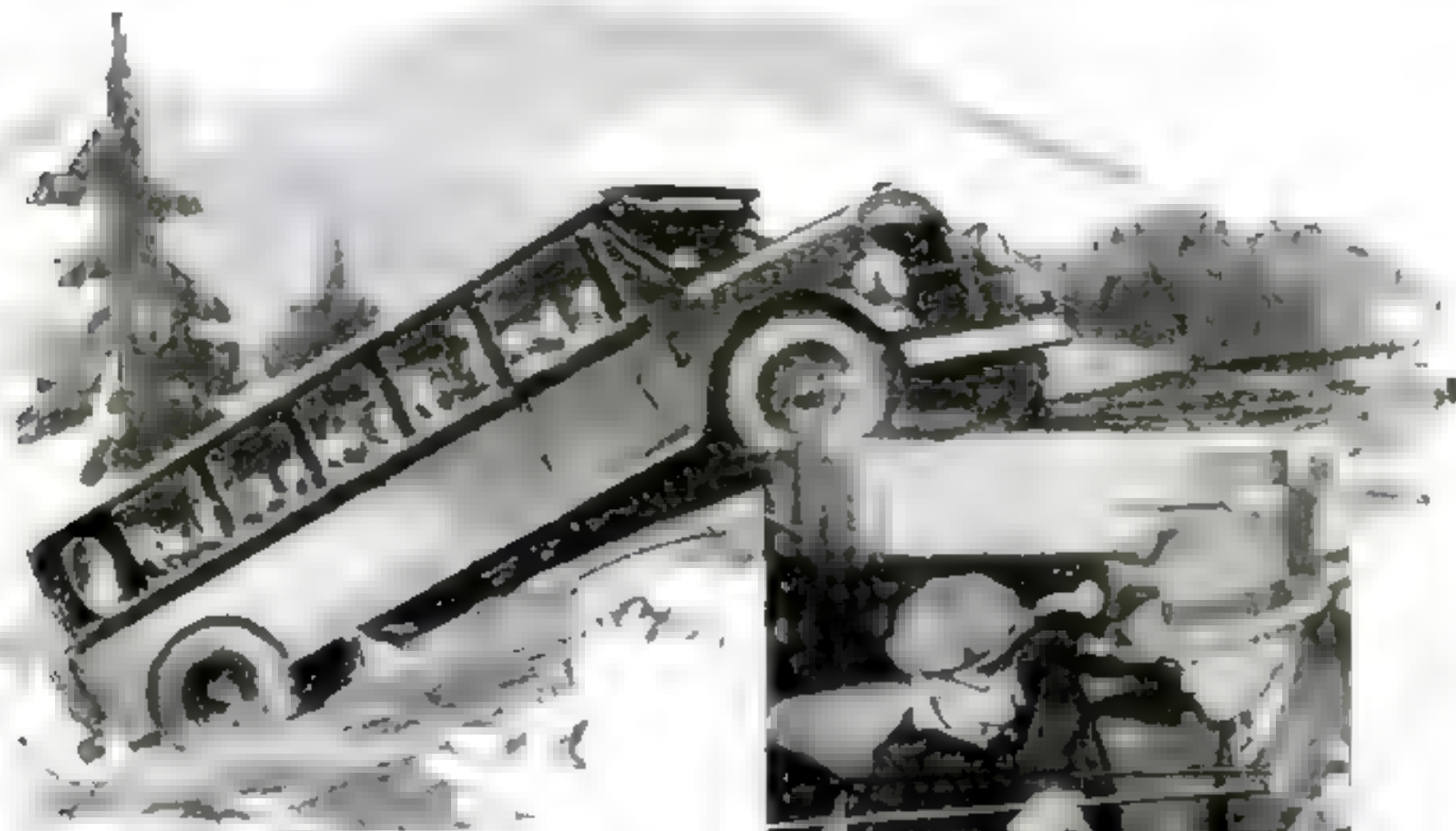
The diamond should not project beyond the cap any. (Continued on page 115)



Gage for verifying the size of a drill and at the same time showing the concentricity of the point, the correctness of the cutting angle, and also the amount of clearance.



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Turning Oversize Work in a Lathe

How to Prevent Sagging Saving Strain by Use of a Faceplate in Place of a Chuck—Steady-Rests

By HENRY SIMON



Work irregularity is often required to set up a heavy rod awkward resting in a small lathe.



bore will be tapered outward, while it will be larger at the inner end when the tool is below

LATHE work, as a rule, is balanced statically. In large and ponderous castings revolving at slow speed, this is all that is required to counteract the gravitational pull which might otherwise cause uneven running of the spindle under the changing eccentric load. Balance, however, is not always the only point which has to be considered. With very heavy work, the weight of the work itself, whether it is eccentric and unsymmetrical or not, becomes a factor when it is large in proportion to the size of the lathe.

What is meant is shown in Fig. 5, page 114, at A. The heavy weight of the large casting causes a bending moment in the spindle, which is thus deflected downward and in turn distorts the work. The spindle itself may spring slightly; certainly there will be "give" in the threads of the spindle nose, as well as in the various parts of the chuck or in the web of the faceplate. What actually happens is that the part revolves around an axis of which the front portion is at an angle to the rear portion, producing an effect somewhat similar to that of a flexible or universal-joint shaft. Many exasperating errors in costly jobs are due to this condition without the cause being recognized.

Even where it can be applied, the indicator does not show this kind of error because the plane in which the faceplate or chuck revolves, while inclined at an angle to the vertical, remains parallel to the traverse of the compound rest on which the indicator is held as may be seen from the diagram at B, Fig. 5. Even where the work already has a true cylindrical surface that can be indicated, this error usually goes unnoticed because, especially with large work, the mechanic applies the indicator to the side. So used, the indicator will show eccentricity, but it cannot show sag or deflection of the spindle.

The difference can be seen in Fig. 4. It will be noted that while the movement of the eccentric piece at A must be registered no matter which way the indicator is applied, the piece held on the deflected spindle at B describes a path concentric with the spindle axis at that point, and

the indicator will therefore be at rest. As the sag is only downward, the error cannot be seen by running the indicator along the side of the work, as at a in diagram C. It should, instead, be run along the top or bottom as at b.

Now, it might be argued that as the indicator run along the side does not show the existence of any sag, so no trouble will result by applying a tool under the same circumstances. This may or may not be true. There will be no noticeable error if the diameter to be turned is large and the tool is applied almost exactly central. Particularly with bores, however, the diameter is often comparatively small even in large work. And in bores as well as outside turns, the tool is usually applied below or above center.

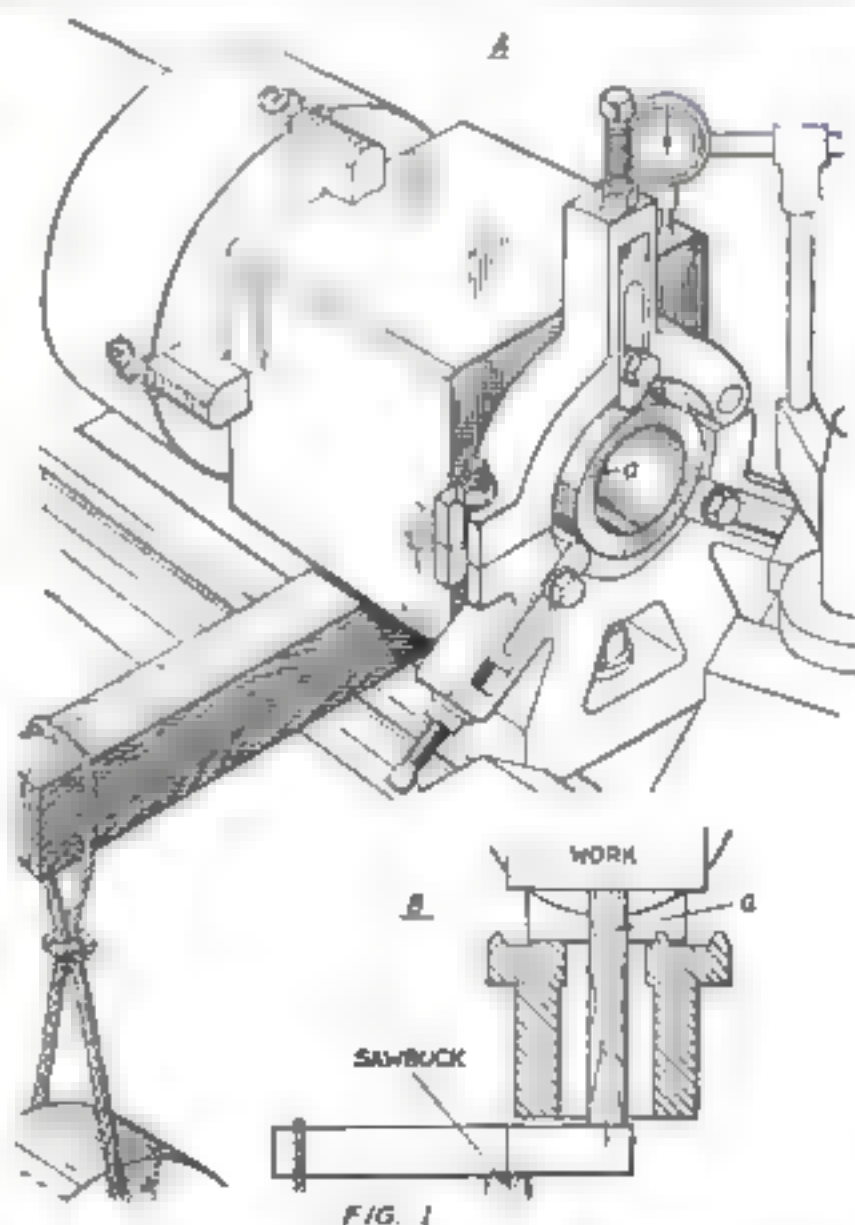
Some of the resulting possibilities are shown in the diagrams and table of Fig. 2, where it will be seen that the error caused by having the boring tool $\frac{1}{16}$ in. off center in a 1 in. hole results in a taper of .0007 in. in a bore 6 in. long, even with a sag of only .0005 in. per running inch.

WITH the sag increased to .001 in.—or less than $\frac{1}{16}$ in. over the entire 15 in. length from the front spindle bearing to the end of the work—the difference rises to .0015 in., which is more than enough to spoil many a piece of work. It is interesting to note, and will sometimes be useful to remember, that with the tool above center as at A, the

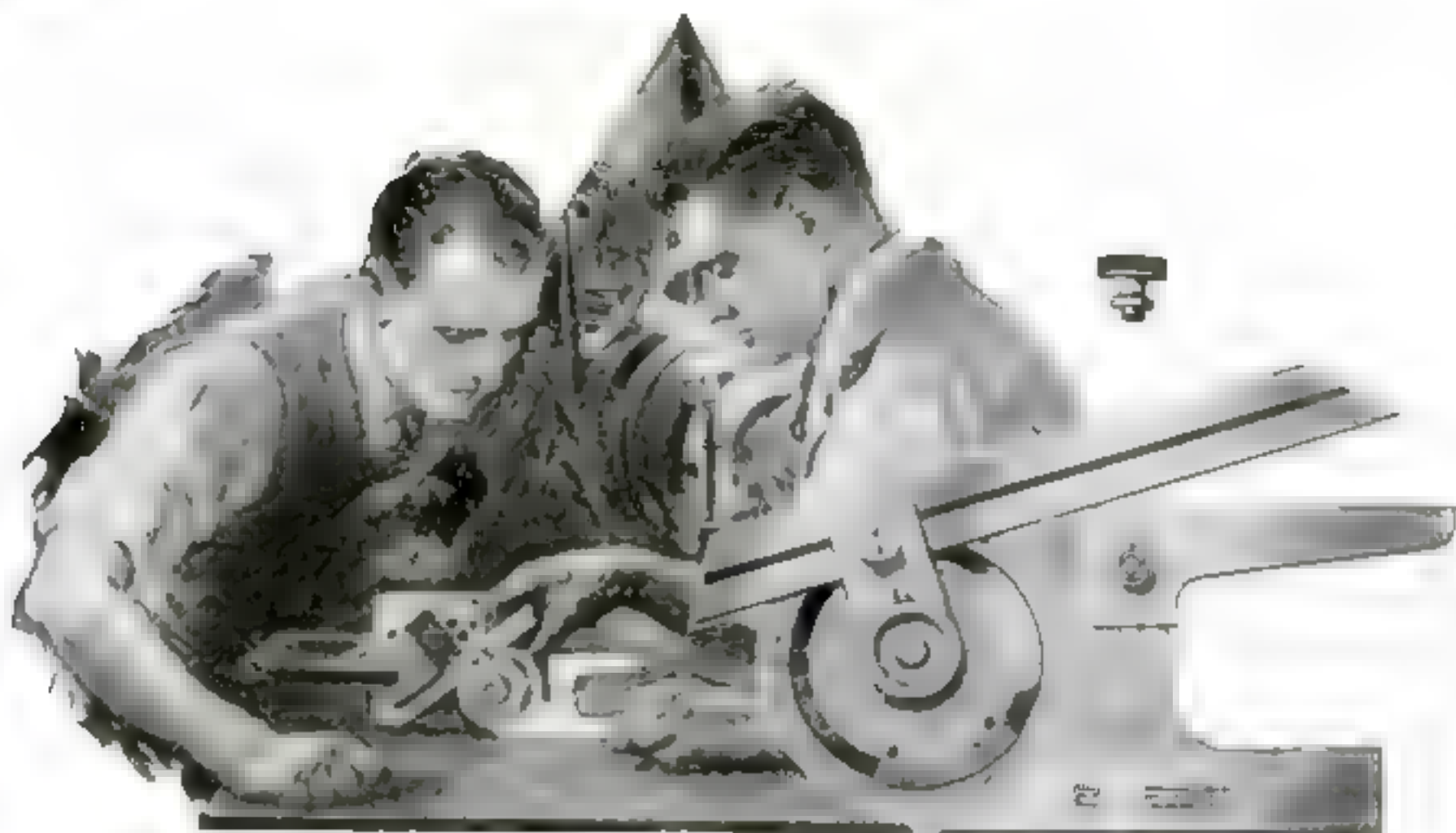
bore will be tapered out-

ward, while it will be larger at the inner end when the tool is below center as indicated in Fig. 2 at B. Now the evident remedy for spindle sag would be to use a heavy enough lathe for heavy work. This is excellent advice, and would be even better if it could always be followed. But most of us are not in the fortunate position of being able to pick the right tool every time, and the faithful little old lathe will have to continue handling many a job that stretches its capacity. There are ways out of almost everything, however, and so there are ways out here.

With smaller bores, the use of an expandable reamer (Continued on page 113)



Setting up a casting on which a "stub" or extension has been provided and turned to a suitable diameter to allow a steady rest to be used.



Accuracy Grows More And More Important

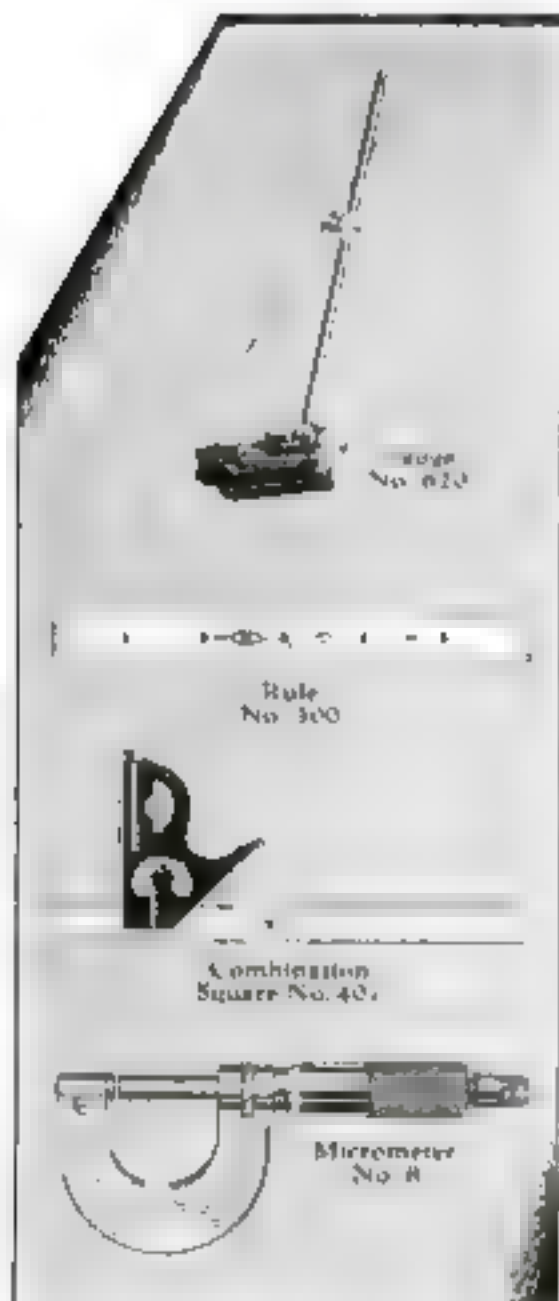
In many cases, today's product must be held to limits closer than one thousandth of an inch where yesterday's passed muster at less exacting standards. Why? Simply because today's manufacturer has learned that faster and more profitable production follows close in the wake of smaller tolerances, or working limits.

All along the line, fine measuring tools are needed to make high precision standards possible. Manufacturers, tool-makers, and mechanics everywhere rely for this work on Brown & Sharpe Tools, known the world over for their quality and unfailing accuracy.

The tool shown above is Bevel Protractor No. 496. Get a copy of Catalog No. 30, describing this and over 2300 other Brown & Sharpe Tools, from your hardware dealer. Or write us for one. Address Dept. P. S., Brown & Sharpe Mfg. Company, Providence, Rhode Island, U. S. A.



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GLASTONBURY CONN. MONTREAL CANADA

Next time say

Williams
Shaving Cream

Please!

Afterwards find out how perfectly AQUA VELVA completes the shave. Made just for that.

Choosing a Paint Sprayer

F. N. VANDERWALKER *Describes the Various Types of "Guns" Available for Home Decorating*

"I HAVE just been looking at two or three paint spray guns," a friend of mine remarked to me not long ago. "They sell at less than \$10 and look excellent. I would like your opinion as to which one it would be best to buy for painting the three large barns on my farm."

His was an innocent request for information typical of a thousand and one questions being asked by amateur painters and decorators who wish to take advantage of the spray guns being sold for home use. And it is not always easy to obtain informative answers.

The would-be purchaser is told that they are great labor-saving tools for the application of paint, lacquer, enamel, varnishes, and other decorative and protective coatings. He has to explore a bit for himself before he can hope to find the limitations of the half a dozen or more types of spray guns.

Let us see just how the spray gun works and we shall better understand what constitute reasonable expectations from this most useful tool. The spray gun is a tool through which a stream of air and a stream of paint, lacquer, varnish, or other liquid are passed, the air breaks up the liquid, atomizing it and projecting it upon the surface to be coated. Some types permit the atomization to be controlled exactly as to uniformity and volume; others allow only a partial control.

In the simplest type of gun the paint or other liquid is supplied from a container near the nozzle by siphonage. One end of a small tube or pipe is inserted into the liquid and its other end opens just back of the nozzle hole in the end of



the gun. When a stream of air is projected past the upper opening, the liquid rises through the tube; the air stream then atomizes and projects it on the

surface being painted or otherwise decorated. A study of the tabulation on page 100 will show that the types marked A, B, C, and F use the simple siphon system.

In a second type of sprayer the material is contained in a cup above the gun or in a large container from which a hose leads to the nozzle, and the feed is by gravity.

A third type is fed by pressure. The material is carried in a tank lower than the gun and a pressure of from five to

The kind and amount of work you wish to do govern your choice of a spray gun.



thirty or forty pounds is applied in the tank to force the liquid to flow up into the gun.

It is obvious that a heavy liquid, such as paint weighing from fourteen to twenty pounds a gallon, will require an air stream at higher pressure to lift it to the gun and to atomize it than a wood stain or thin lacquer which does not weigh nearly so much. Consequently, it is well to thin the heavier liquid with from ten to twenty-five percent of turpentine, benzine, or lacquer thinner in order to make them spray to best advantage when the air supply is limited—and, indeed, sometimes when it is not.

Generally speaking, there are two types of guns. One requires a relatively high pressure—from forty to sixty pounds—and less volume of air than the other. The ports or holes in the nozzle of high-pressure guns are smaller than in the low-pressure types, which use a much larger volume of air at a pressure of about twenty pounds.

The three air supply factors are pressure, volume, and duration. The capacity of a spray gun of any type is limited by these factors. Spray guns such as those marked A, B, C, D, and E, which are supplied with air by means of a hand or foot (continued on page 100)



The spray gun above is of the siphon type, with a large pressure feed. The gun at the left is of the siphon type and has a manual pump to start for the paint.

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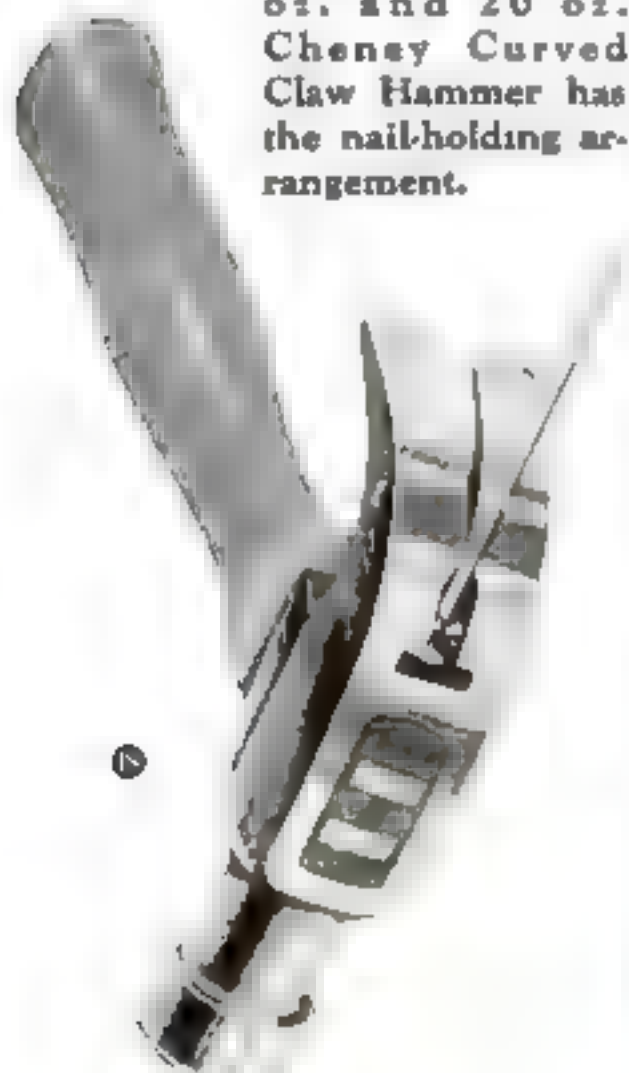
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Choosing a Paint Sprayer

(Continued from page 98)

pump or a very small electric motor, necessarily are limited in air volume and air pressure. The hand and foot pump types also are limited in the duration of the supply; that is, the air supply is not as steady as it is with an electric motor.

decorating surfaces of a limited size. With the smaller guns it is impractical but not impossible to paint large surfaces.

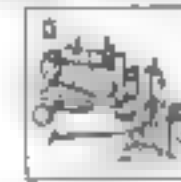
Spray guns supplied with air by electric motors—those having a tiny



Types of Spray Guns and Their Uses

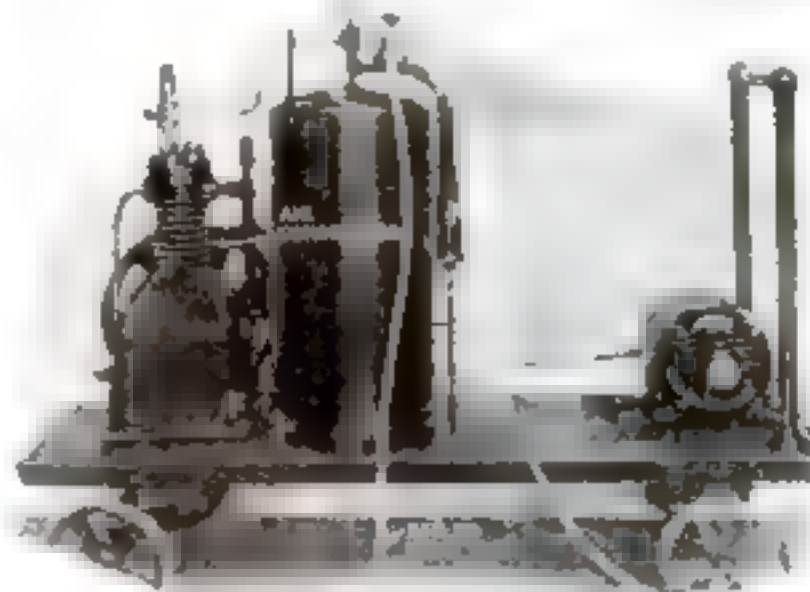


Type	Price	Air Supply	Pressure	Feed	Regulation	Materials Handled	Surfaces Practiced to Finish
A	\$2.00	Hand pump	Low	Siphon	Limited	Paint, lacquer, enamel, varnish, stain, wax	Furniture, touch-up work, radiators, picture frames, auto fenders, all small objects
B	\$4.50 to \$15.00	Foot pump	Low	Siphon	Limited	Same	Same
C	\$4.50	Vacuum cleaner	Low	Siphon	Less limited	Same	Same
D	\$35.00	Very small electric motor	Low	Siphon and pressure	Certain	Same	Furniture, radiators, spray, exterior walls, so complete refinishing, exterior and interior house work
E	\$40.00	Very small electric motor	Low	Siphon and pressure	Certain	Same	Same
F	\$100.00 to \$120.00	1/4 to 1/2 H.P. electric motor	High and low	Siphon	Certain	Same	Same, also larger surfaces
G	\$500.00 to \$1,000.00	1 H.P. and larger motor and gas engine	High and low	Siphon, gravity, pressure	Certain	All materials that can be brushed and others	Furniture, automobiles, interior trim, floors, walls, exterior of houses, barns, metal, brick, concrete, ship guns, etc.



Because of these limitations, the practical usefulness of these hand and foot pump sprayers and the small motor types of spray guns is mainly for coating chairs, tables, radiators, and wicker furniture, for touching up automobiles, and for

motor mounted directly on the gun or located separately near by—have greater capacity than those which depend upon hand or foot pumps. It is practical to use them for painting a garage, fence, or small room interior, and, of course, an automobile, but they will hardly serve for painting a large house or a barn.



Paint spraying outfit with air compressor driven by an electric motor. It can be used with either spray gun shown on page 98.

Among the small motor-driven spray guns there are, in general, three types. One mounts the motor on the spray gun handle and depends more upon a large volume of air at low pressure for atomizing the material than upon a smaller volume of air at high pressure; from twenty-five to thirty pounds pressure is the maximum of this type. The second type is that using the siphon principle gun and having a very small electric motor as a separate unit. These guns also come within the low-

(Continued on page 107)

Cannon for Shooting Snowballs

By HI SIBLEY



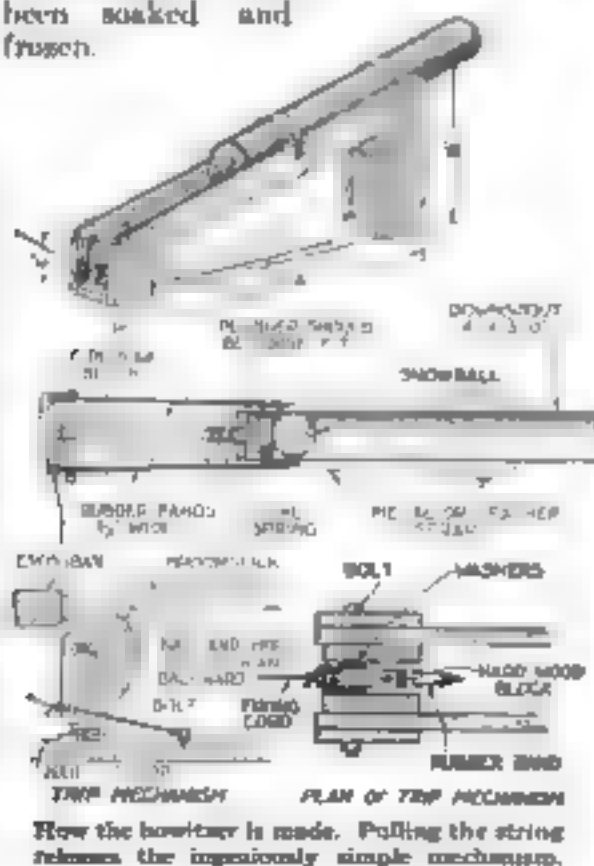
A length of old downspout or stovepipe forms the barrel of this unusual snowball howitzer.

AS THE winter campaign in the War of the Vacant Lots becomes more furious, defenders of the fort will need more powerful artillery. By constructing a snowball howitzer as shown, they can hold off a strong enemy force.

The power is obtained from $\frac{1}{4}$ in. wide rubber bands cut from a discarded inner tube, preferably one which retains considerable elasticity. A coil spring is slipped over the broomstick before the firing mechanism is assembled to take up the shock of the plunger when fired.

Upon the neatness of the firing mechanism depends the efficiency of the howitzer. A $\frac{1}{4}$ -in. thick, hard wood block shaped as indicated forms the foundation of the trip. A rubber band holds the trip block in position until fired, and a stop at the bottom prevents the band from pulling the block too far forward. A cord is attached to the lower end of the block.

For ammunition, pack your shells from moist snow, but remember that the Committee on Armaments of the League of Vacant Lots absolutely outlaws any snowballs that have been soaked and frozen.



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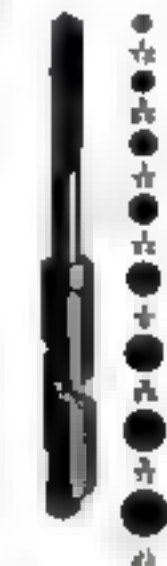
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Upholstering Old Chairs

By R. C. STANLEY

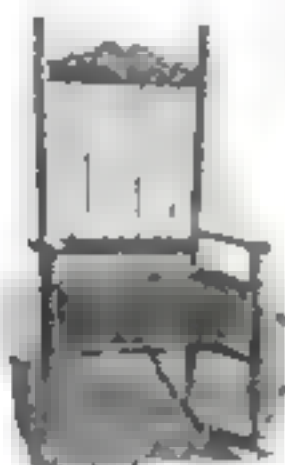


Fig. 1. A comfortable rocking chair salvaged from the one in Fig. 2.



Fig. 2. If this chair could be repaired, is any chair beyond hope?

DISCARDED chairs, whether modern or antique, can be salvaged in many cases by replacing the upholstery or by substituting upholstery for rush, splint, or other types of seats.

It is surprising what can be done with an apparently hopeless-looking chair. Some can be made fully as good as new, others, less attractive in their original design, can, nevertheless, be made comfortable and serviceable for use in a spare room, a child's room, or other room where extra seats are needed.

The chair shown in Fig. 2 was junked until the writer salvaged it to serve as an illustration of what can be accomplished in repairing a particularly poor specimen. Figure 1 is the same chair with all of the old willow removed and the old back replaced by a "slat and spindle" back. The new seat is of the bar and spring type, pieces having been added to form an apron to prevent the springs from showing underneath. Note in Fig. 3 how the springs are tied to keep them in position.

In Fig. 4 is shown a very important part in the reconstruction of seats. Two layers of the best grade of burlap have been stretched over the springs and tacked to the apron. A $\frac{3}{4}$ -in. wooden rod is nailed to the top of the apron to form a "roll," which holds the seat filling in position and retains the shape given the new seat. This "roll" also may be made with rope or with flax tow twisted into a roll and similarly nailed.



Fig. 3. The bar and spring method of upholstering a seat. Note how the springs are tied.

The next step is to fill the seat with a good grade of flax tow. There are a number of materials with which seats may be filled, but tow is preferred by the writer, who has removed upholstery fillings of every description from old furniture and has found none to be in as good condition after a number of years of hard service as the tow. I have removed tow that was known to be well over a hundred years old, knocked the dust out of it, pulled it



Fig. 4. The springs are covered with two layers of burlap and a rod is added to form a "roll."

apart to "fluff it up," and used it again in the same job; it was as good as when new.

Fill the seat well and evenly; don't skimp the filling. The reason for all chairs is the seat, which should be comfortable.

Three pounds of tow were required to fill the seat as shown in Fig. 1. Stretch burlap or any kind of cloth over the filled seat and tack it to the apron, this gives the seat the form desired.

Now is the time to clean and refinish the chair. If this part of the job were the first to be done, it would more than likely have to be done over again after so much handling. The chair illustrated originally had a clear varnish finish; it was refinished with mahogany varnish stain. Figure 1 shows it a better and more comfortable chair than when new, although with this particular kind of chair it is hard to decide where it belongs, it is being used now in a bedroom.

After the job is refinished, the final covering is put on. (Continued on page 110)

Blueprints for Your Home Workshop

OUR blueprints can be obtained for 25 cents a sheet. In some cases there are two or three sheets to one subject. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. Other subjects besides those below are to be had; send a stamped envelope for the complete list.

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30.	Tool Cabinet, etc.	Jan., '24	25c
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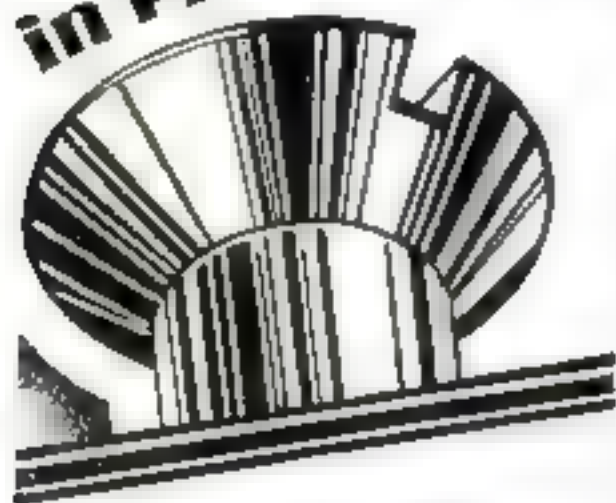
No doubt your present shaving preparation suits you—still there may be a better way. If there is you want to know it. So won't you let us prove, on your face, how excellent this unique product is? It's up to us to prove our point, you've lost nothing if we fail. Please mail the coupon now.

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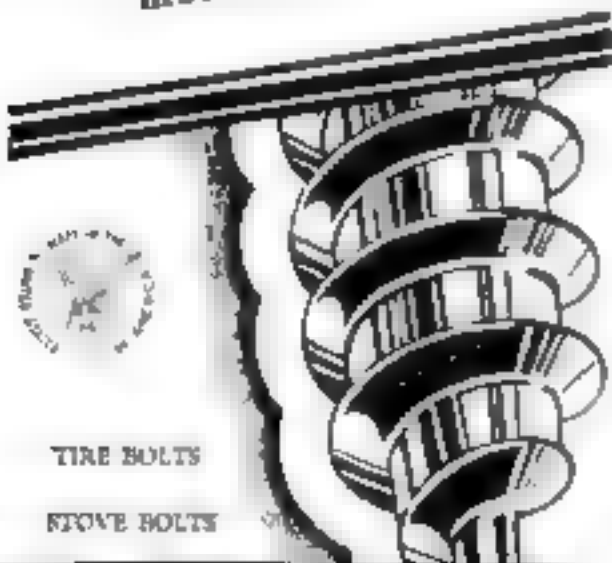
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TIRE BOLTS

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Whittling Model Propellers

Methods Used by Prize Winners in Miniature Aircraft Contests—Bending Bamboo—Other Hints

By A. L. JACKSON

BEGINNERS in airplane model making always wish to know how experts like my little friend Aram Abgarian, who won the Stout Indoor Trophy with a flight of 333.8 seconds, carve the propellers for their record-breaking models.

The first requirement is a good sharp pocketknife. The next is to have suitable material for the blank. In the majority of cases a beginner will use clear, soft white pine unless he is making an especially light model with a framework of balsa wood, in which case the propeller also may be whittled from balsa.

The ideal propeller is of the "true screw" or "true pitch" type; that is, it has a uniform pitch throughout and therefore insures the utmost dynamic thrust and delivers the maximum power.

A long narrow blade is better than a short stubby one. A good ratio for large "props" is six to one in the relation of length to width, although wider propellers are often used with good results, the extreme being represented by a ratio of four to one. Generally speaking, the widest part of the blades should occur about two thirds the length from the hub.

This is the simplest and most effective way I know for a beginner to attain a true screw prop:

Take an oblong blank and square it up on all sides. Assuming it is a right-hand prop desired, draw accurate diagonal lines on both faces of the block (Fig. 1). Where the diagonals cross each other, drill the hole for the propeller shaft.

Next saw or cut away the wood following the face diagonals, but leave an approximate width of $\frac{1}{4}$ in. at the hub. The blank will then resemble Fig. 2.

Draw diagonals on the end of the blank as in Fig. 3. They must be exactly

opposite from each other on each end, that is, the lines run right-hand from bottom to top on one end and vice versa on the other end.

Hold the propeller blade in your left hand and, starting at the hub, carve away from you. You are really carving to these end diagonals you have drawn. Then, on the same face but in opposite direction (just turn blade around in your hand), carve to the other end diagonal (Fig. 4).

Put a slight "dish" or camber in the blade at this stage. Use fine sandpaper and hollow slightly the full length of the blade, but not too deep. After that, carve the other side to conform to the hollow on the front (Fig. 5). Sandpaper the blades down until you can see light showing faintly through them when you hold the prop up to a window. Then, and then only, should you round the tips. A coin may be used as a template for marking the ends.

A special blank is not essential for a toothpick propeller. Just slice off the tip edges of a prop made as described. This will leave a prop with a very narrow pointed blade as in Fig. 7, slightly rounded at the extreme tip. It is a very fast prop and often used on speed models.

The efficiency of the prop varies from nothing at the hub to a maximum at the tips. Weight is an important factor in good flying models, and, since the hub is worthless and offers a hindrance to gliding, cut away as much of it as possible on the front or hollowed side, not the back (Fig. 6). This will not injure the looks of the prop and will reduce its weight and increase the efficiency. However, you must leave at least $\frac{1}{4}$ in. in thickness at the hub or you'll break your *(Continued on page 105)*



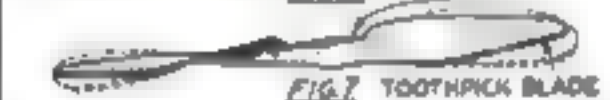
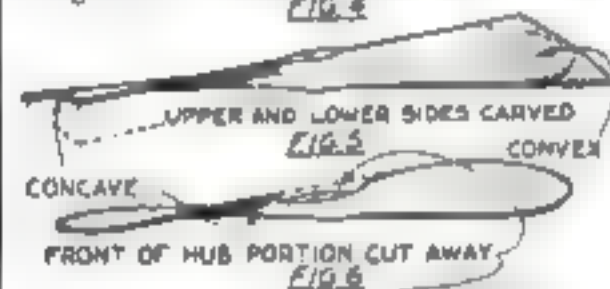
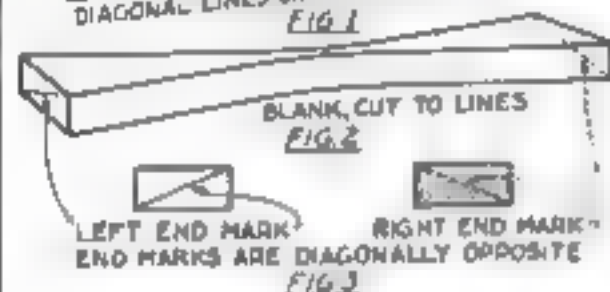
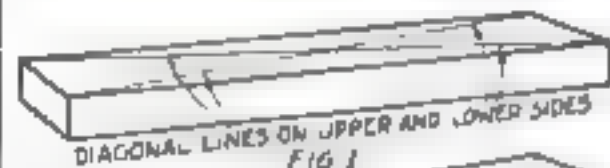
Whittling Propellers

(Continued from page 104)

blade in the process of winding the motor. Instead of using a pencil to lay out a balsam wood blank, use a metal-edge rule and a knife. Sink the point of the knife into the soft wood for the diagonals on the face of the blank. Be sure to leave the hub wide enough so that it will not break while you are doing the actual carving. You can trim or tear away the wood outside the diagonals and have a straight true edge to carve to throughout the operation.

The propeller shaft is of vital importance. It must be neither too long nor too short and must be absolutely true or it will cause vibration. Use shafts from 1 to 2 in. in length on small models and from 3 to 4 in. on larger props of 8 in. or more.

Pass the shaft through the hub after install-



Steps in marking and carving a propeller. Note that the concave faces are the first to be shaped.

ing a washer and see that the cut-away portion of the blade is the front. Bend a square 1 in. in the end of the shaft as in Fig. 8, assuming you have already bent a rubber hook on the other end. Give this U a wrap or two of silk thread soaked in an ambroid type of cement and pull it back into the hub with the point of the U down and towards the cutting edge of the prop, tap it gently but firmly in place.

A propeller bearing that I find efficient and practical is made from a piece of a cutter pen (Fig. 9). A small pen is used for little models and a larger one for big models. One end of the piece is flattened but not made too thin, and a hole is drilled in it for the propeller shaft. The hole can be made by driving the point of a photograph needle through it. Cut the piece down as small as practical in length and bend it as shown.

Two things should be remembered. First the only point of contact between the blade and the thrust bearing should be at the hub. If the blade strikes at any other point, the prop will be sluggish in action. Secondly, it is of equal importance to see that the thrust bearing is not too high or low. The motor stick will bend and perhaps break if the bearing is too high, and if it is too low the motor will not clear the stick. The best method to determine the height of a thrust bearing is by experiment.

The precautions just outlined apply also to the rear rubber hook on the opposite end of the motor stick. I (Continued on page 106)



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Whittling Propellers

(Continued from page 185)

stretch a thread from the rear hook through the "ears" of motor guides to the thrust bearing at the front. If the thread clears the stick at a sufficient height to allow several strands of rubber to unwind freely, and if it passes directly through the center of the ears and the front thrust bearing, I know that there is little chance for motor trouble to develop.

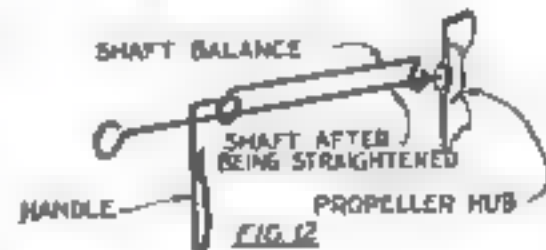
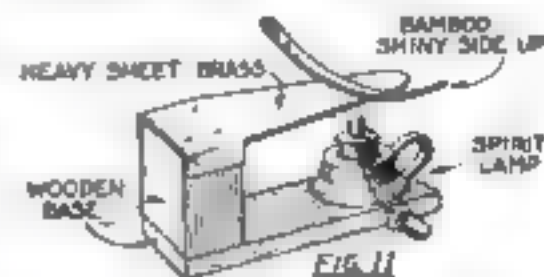
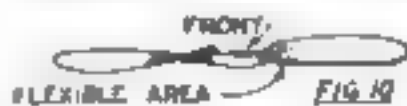
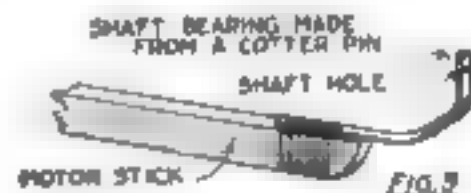
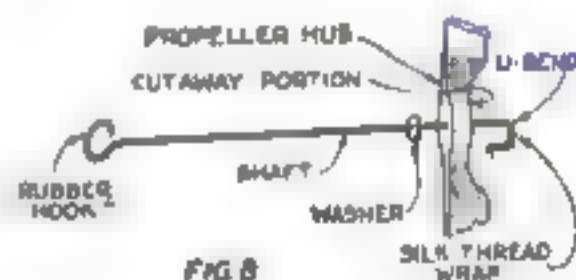
A new kind of prop that would offer possibilities for the experimenter would be one with a flexible blade portion near the hub to allow an expanding pitch (Fig. 10).

A little known fact about A-frame type models with twin propellers is that the propellers do not have to clear each other. I have flown models with the props overlapping a full half inch. Traveling at the same rate of speed as they do, they seldom crack or touch each other.

While many model makers depend upon a candle for supplying the heat to bend bamboo, a special bender can be made from a few scraps of wood, a piece of fairly heavy sheet brass, and several nails as shown in Fig. 11. A spirit lamp of some sort is also needed. One can be made from a common sewing machine squirt can equipped with a wick. The brass gets hot in an instant and the bamboo can be bent without the danger of charring it or burning your fingers.

Before any bending is done you must have a full size drawing for the wing tips, rudder outlines, and the like. Select a piece of bamboo a few inches longer than necessary and wide enough to make several of the frames under construction. Before doing any bending, turn the bamboo shiny side down on a flat surface and with a knife or razor blade scrape away the soft side until the piece is of the exact thickness desired. Be sure that this thickness is as uniform

(Continued on page 187)



Methods of making shafts and bearings; a bender for bamboo; and a shaft balancing device.

Whittling Propellers

(Continued from page 106)

as possible throughout; accuracy is essential. Hold the bamboo in your fingers, shiny side up, and slide it gently with slight pressure over the hot brass plate. You will be able to feel it give when it is warm enough to be pliable. Sometimes the bamboo will become black on the underside, but if you keep the actual flame from touching it, there is no danger of its burning. After bending to shape, hold the bamboo and blow on it to cool it, then it will retain the contour.

THERE are several methods of splitting it. Perhaps the best is to split it down the exact center and then split the half pieces down their exact centers, continuing until the pieces are reduced to the correct sizes.

A wire propeller hammer made as shown in Fig. 14 is used to straighten a crooked propeller shaft. Place the propeller shaft in the two loops and revolve it. You will be able to detect the slightest bend or irregularity.

Remember that a large amount of undisturbed air passing over a fin or elevator gives the most stability. For that reason a high fin or a wide elevator is to be preferred.

An interesting point in connection with the tiny indoor model described by Bunch and Koch in the November, 1928, issue of POPULAR SCIENCE MONTHLY is that it can be flown also as a "pusher." Turn it around with the rudder to the front, set the wing ahead so that the model will climb, and wind the propeller backward. By putting a left-hand prop on it, the model can qualify for a regular indoor pusher. With an almost identical model William Chaffee sailed thirteen seconds to the world's record a few years ago.

Choosing a Paint Sprayer

(Continued from page 100)

pressure class, although there are variations between individual guns. The third type using small motors is that in which a gun attachment fits on the blower of a regular household vacuum cleaner. This is a low-pressure gun. As all the motor-driven guns furnish a steady supply of air, an excellent class of work is possible with them. They are convenient and reliable.

The next larger type of gun uses a siphon feed as a rule, but has a one quarter or one half horsepower electric motor with a small air compressor as a separate unit. Because of its greater air supply, such a gun naturally has a greater capacity than the kind just mentioned. It is designed for automobile and furniture finishing and is practical also for interior wood trim and walls of homes.

For painting houses and barns, finishing automobiles and furniture, and for large surfaces generally, spray gun outfits such as G are used by professionals. The outfit of this kind shown at the bottom of page 100 has a one-horsepower electric motor and a compressor which delivers seven cubic feet of air a minute at any pressure up to more than 100 lbs. In ordinary operation it is regulated to use about twenty lbs. pressure on the paint supply tank and from thirty to sixty lbs. pressure on the gun to atomize the paint. There are air and paint storage tanks of large capacity, together with air regulating valves and a water and oil separating device, to keep the air stream clean. Either a siphon type of gun or a pressure-feed gun is used with this outfit.

Mr. Vanderwalker, whose books on painting, the use of spray guns, and the like are regarded as standard reference works in the painting trade, will tell how to operate hand and foot pump sprayers and motor-driven spray guns in an article scheduled for early publication. He will explain for beginners how various surfaces should be finished.

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A definite program for getting ahead financially will be found on page four of this issue

Ready to Build

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

THE man who varnishes a piece of furniture or some apparatus which he has just made, or the woman who touches up a chair, is apt to discover certain pertinent facts about varnishes from annoying experience.

Some brands dry too quickly for general use and fail to form a smooth surface. Others require several days for drying, making it impossible for the amateur to produce a clean job without a dust-proof room. Still others dry to a dull, unattractive film or else produce a brittle one which chips easily.

However, the standard Government tests on varnish, most of which the amateur can easily perform, furnish a means of determining accurately the appearance, drying time, and elasticity of the film, and there are special tests for varnishes designed for special purposes. By purchasing only a small sample, or borrowing a few ounces from a neighbor, one can test any brand and often prevent considerable waste in time and money. These tests follow:

Cut a panel about 8 by 8 in. from a clean sheet of tin of a grade weighing about half a pound to the square foot. This is rather light sheet and is specified because it gives a thickness which is ideal for the elasticity test. Hold the panel vertically by one corner, pour a portion of the sample over one side, and allow the excess to drain off. Place the flowed panel in a nearly vertical position in a well-ventilated room, away from the direct rays of the sun, and leave for four hours. At the end of this interval give the so-called "setting to touch test" by lightly touching the film not less than one inch from the edge. The varnish can be considered as passing this test if none of it adheres to the fingers, although it may still be soft. This means that the film is in no more danger of catching lint and dust.

TWENTY-FOUR hours from the time when the varnish was first flowed on, test again by using a firm pressure of the thumb and finger. If the finger does not move the film and leaves no mark which remains noticeable after the spot is lightly polished, the varnish passes the "drying test." Observe the panel carefully in a good light. The film should be smooth, glossy, and free from runs, sags, pits, and other defects.

Leave the panel for another twenty-four hours. At the end of this time, test for elasticity and toughness by placing the tin in water at a temperature of from 70 to 75 degrees (Fahrenheit) for a few minutes; and then, with the film outward, bend it rapidly over a $\frac{3}{8}$ -in. rod until the panel has been bent double. Examine the film in a good light. A satisfactory varnish, judged *(Continued on page 109)*

Home Workshop Chemistry

(Continued from page 166)

by United States Government standards, will show no cracking or flaking.

These general tests can be supplemented by several valuable tests for varnishes designed for special purposes. For example, the cold and hot water tests which have been made familiar to the general public in advertisements.

Pour a little of the varnish to be tested on two tin panels and let them dry for forty-eight hours, as described above. Then dip one of the panels into a bowl containing $2\frac{1}{4}$ in. of pure water at room temperature, immersing the end which was uppermost during the drying. Leave for eighteen hours. Ice water is not necessary and, indeed, is not ordinarily used for this test. Remove the panel and dry at room temperature for two hours. The panel must show no whitening and no more than a slight dulling. In the same way, immerse the end of the other panel in $2\frac{1}{4}$ in. of pure boiling water and leave for fifteen minutes. Then remove and dry for two hours. This panel also should show no whitening and no more than a slight dulling.

AN OLD-FASHIONED Navy test for spar varnish, called the "safety of working test," should be of interest to amateur boat builders and other users of exterior varnish. This is designed to determine whether a film will stand a stiff breeze while still wet.

Flow a standard tin panel and immediately place it in the direct draft of a small electric fan (8 or 10 in. across the blades) running at full speed. The panel should be in a nearly but not quite vertical position, approximately 8 ft. from the center of the fan, and set sideways at an angle of 45 degrees to the line of the air current. Leave it in this position for five hours. Then set it aside and allow the varnish to harden overnight under ordinary conditions. The varnish should give a smooth film and appear free from dulling, crow's footing, or frosting.

Probably more floor varnish is used than any other kind, so one of the greatest needs of the amateur brush-wielder is to find a good varnish of this type.

Build a large wooden panel with one side carefully planed and sandpapered and place it just inside the garage or workshop door. It should be of such a size that any one entering must necessarily step upon it. Now mark it into approximately 8-in. strips, each parallel to the door sill. Next borrow or beg from the neighbors as many samples of different kinds of floor varnish as you can find and paint a different strip from each can. The length of the panel will depend on the number of brands to be tested. Keep a record of the brands by number and leave the panel in the doorway for at least a month. Then clean the surface carefully and observe how the different brands have stood the wear and tear of shoe leather. Sometimes this practical and simple test will yield surprising results.—W. H. HAMMOND.

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Ordinary big-bubble lathers have more air, less moisture. A comparison will prove Colgate superiority. Note our coupon offer of a week's free trial. We will send also, a sample of After Shave, a new lotion—refreshing, delightful—the perfect skin tonic.



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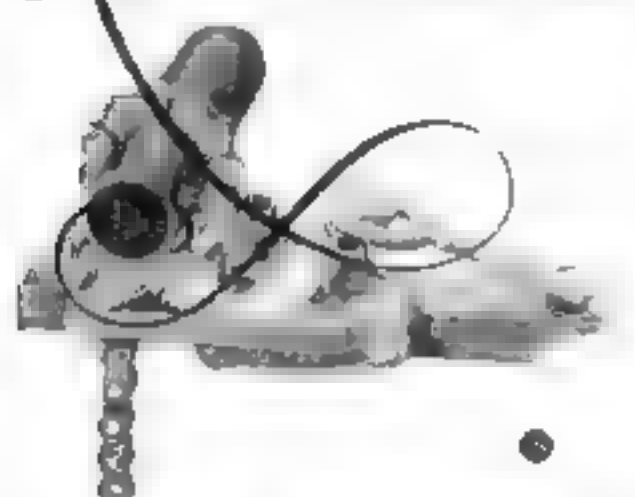
Colgate's lather (greatly magnified) showing moisture contacts with beard and minimum air. A minimum means principle scientifically authenticated and proved and practically by millions of men.



ORDINARY LATHER

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WILLIAMS
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SUPERIOR
CHAIN PIPE VISE

Upholstering Old Chairs

(Continued from page 106)

A good layer of sheet cotton must be spread over the cloth which covers the filling, and all irregularities filled out with cotton. Then the upholstering material is stretched over this and tacked underneath.

All upholstering over springs is done in a similar manner. In many cases the bar and spring method is replaced by webbing and springs, the webbing being tacked to the underside of the framework, as shown in Fig. 4. Coil springs are sewn to the crosses, then tied as before. The bar and spring method is more durable and should be used when possible.

In many old pieces where the wood has been badly weakened by tack holes, the webbing is replaced by bars and springs. As each bar is suspended from the top of the frame, it is not likely to give way.

Springs should be used with webbing only where the seat frame is of the apron type and forms a box in which to set the springs. At the left of Fig. 5 is illustrated the flat type of seat, in which burlap should be tacked directly over the webbing, then the seat filling applied, and the upholstering completed as described.

At the right of Fig. 5 is shown another and more economical, only not quite so comfortable, a way of renewing worn-out seats. In this instance a board of suitable size and thickness is nailed or screwed to the underside of the

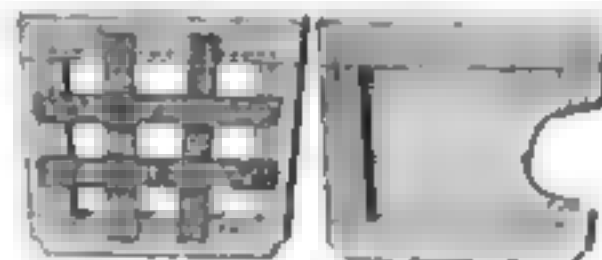


Fig. 5. Whether webbing or a thin board is used to make a foundation for upholstery on a flat seat frame, it is applied on the underside.

seat, then filled and upholstered as just suggested. The dotted line shows the edges of the board.

Figure 5 represents excellent ways of renewing cane, splint, or rush seats. Anyone can make this type of upholstered seat, but it is almost impossible to find a man who can or will renew the seats as they originally were.

Any of the materials whose use is recommended here may be obtained from upholsterers and repair men, as, ordinarily they carry them in stock. Pieces of upholstery materials may also be found at the same places. Many upholsterers stock a goodly supply of samples and remnants of tapestry, velvets, velours, mohairs, plushes, imitation leather, and other materials. These are kept for sale and may be had for from one twentieth to one quarter of the regular price a yard.

There is one kind of upholstering which no one should ever try to duplicate; and when a piece which has this kind of upholstery on it is gone over, it should be changed to plain filling. The kind I refer to is called "beirut tufting"; it consists of wads of tow or other filling with the covering drawn down between the wads with buttons. This method not only catches dirt and dust, but it holds all it catches.

Upholstering, as such, is actually a trade in itself; for those who have had no experience at all, a visit to some repair shop might prove of value. Repair men as a rule are genial fellows. They are usually willing to show others how to do anything they can do themselves. I have found it a pleasure to show a number of persons all I knew about different jobs they wanted to do themselves.

This is the eighth in Mr. Stanley's series of articles on restoring old furniture. The next will be published in an early issue.

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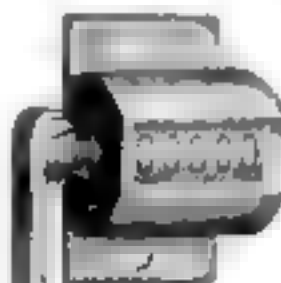
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recording the output or operations of small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The farther the lever

is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price \$2.00. (Cut nearly full size.) Small Revolution Counter, also \$2.00.

Our brown book shows instruments that "count everything on earth." See them—by sending for the book.

Veeder-ROOT INCORPORATED
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Ping-Pong Table

(Continued from page 77)




Fig. 3. Hand screws are used to clamp the reinforcing pieces to each section of the top.

the end pieces of the two sections which are to receive within their recesses the square ends of the disassembled side rails, plane $\frac{3}{4}$ -in. dowels as indicated in Fig. 2, underside view. The dowels are to hold the rails in place while the board is doing duty as a screen.

Cut crosspieces to fit between the long sides of each section. Those for the two middle sections should be cut down to $\frac{1}{2}$ in. in thickness for 10 in. from one end to allow the side rails to be fitted there, as in Fig. 2. Fasten all joints except at the cut-down ends just mentioned with $\frac{1}{4}$ -in. corrugated fasteners.

Place the edges of each section. Level them a very little toward the underside to insure perfect contact between the sections on the playing surface of the board.

In order to make adjoining sections flush at the joint, place five $\frac{1}{2}$ in. wide brass or steel huts on the back of the two outside joints—that is, the joints between leaves one and two and between three and four. To place these, lay two joining sections face down on a flat surface and hold them in perfect contact while all the screws are driven home.

Turn the pairs of sections right side up, bring them together for the middle joint, hold them in perfect contact and put five hinges in place on the top of the board. The plates of these hinges may be set in flush if desired, but they will come under the net out of the way of the game. Place rubber clothes—rubber tipped mallet—in protect both the  of the sections and the floor when the board is used as a screen. All parts of the board itself are now in place.

To finish the table complete in itself, prepare four legs of the dimensions given, preferably of oak or other hardwood. Place them 8 in. from the ends of the top and fasten them with 3 in. wide steel or brass hinges, as in Figs. 2 and 4. See that the entire barrel or round part on the hinge is on the leg. Use 1-in. screws.

Obtain eight hooks at least 17 in. long and sixteen heavy screw eyes, any of $\frac{3}{4}$ -in. wire or No. 5 American wire gauge. Attach four of the hooks with the screw eyes to the inner faces of the legs as shown in the end view of Fig. 2. Raise the legs until they stand perpendicularly, then locate and place the four eyes in the underside of the (Continued on page 112)

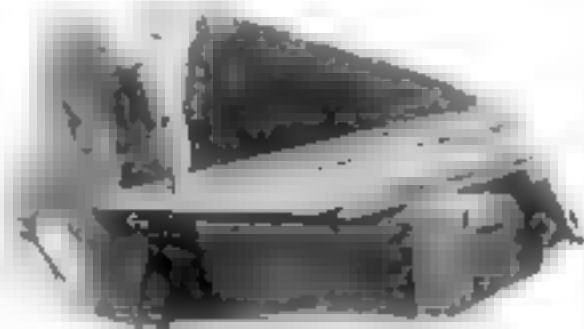
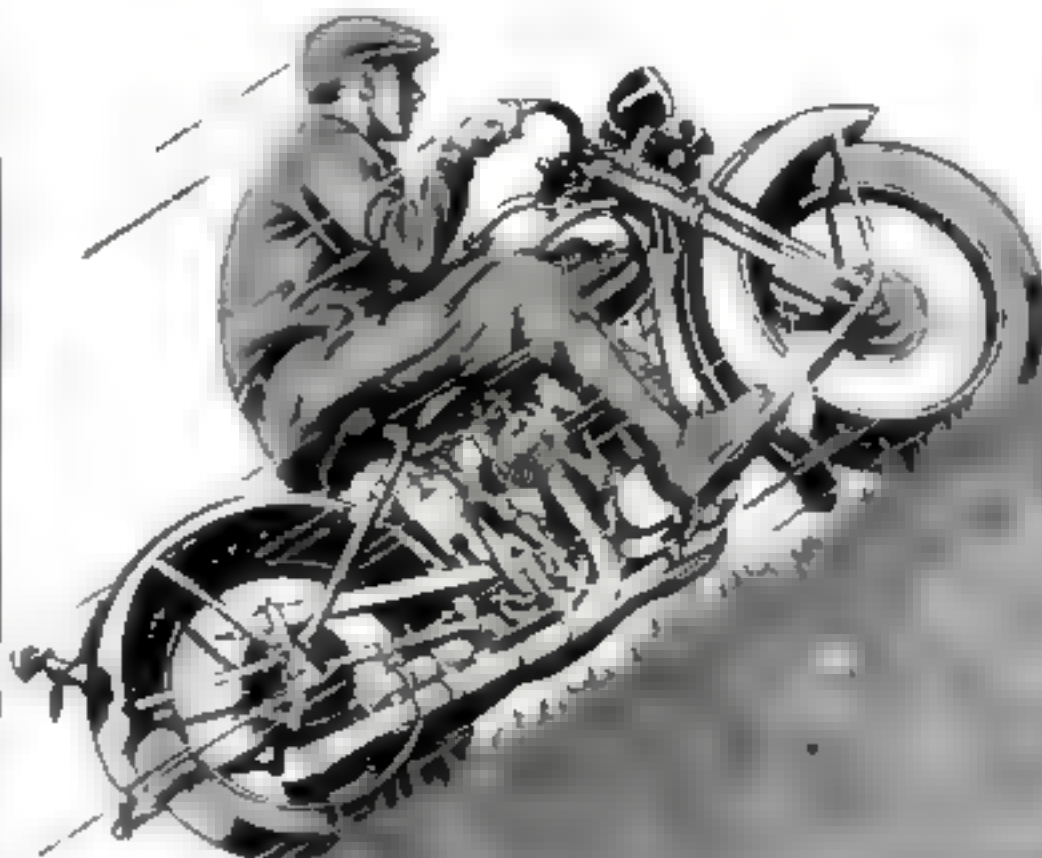


Fig. 4. Mr. King demonstrates how the legs are hinged to the reinforcing strips of the top.



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THAT'S how a New York rider compares his Harley-Davidson to an airplane. And he's right!

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Ping-Pong Table

(Continued from page 111)

top as shown in the same view. Ignore the other four hooks for the time being.

Cut out four rails $3\frac{1}{2}$ by $4\frac{1}{2}$ by $55\frac{1}{2}$ in. long. These are made $\frac{1}{2}$ in. wider than the corresponding notch marked A Fig. 2 of the legs to which they are related; the extra width is to allow for the space left by the hinges of the legs. Slight planing in width, however, may be required.

Make the splice joints as shown in Fig. 3. Verify all dimensions before making these joints to insure that the ends of the rails will be flush with the outside of the legs. Prepare four cleats $\frac{1}{2}$ by $1\frac{1}{2}$ by $4\frac{1}{2}$ in. and fasten them to the rails as shown in Fig. 5 with glue

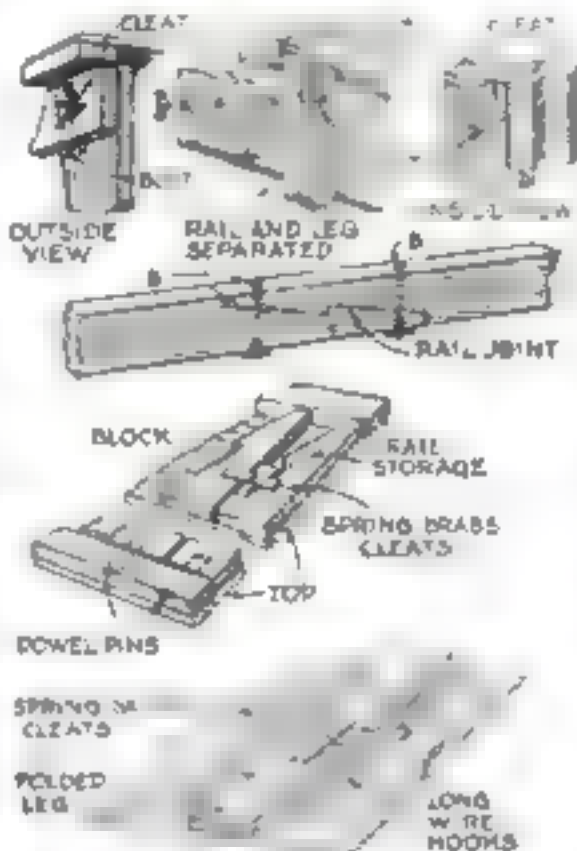


Fig. 3. Details of the legs and rails. How they are held in place with springs when folded.

and $1\frac{1}{2}$ -in. No. 10 screws. Fit the rails in place by making accurate cuts to suit the legs and joints. There should be perfect contact between the rails and the underside of the table top throughout the entire length of the rails.

Bore $\frac{1}{2}$ -in. holes through each aligned joint as at B, Fig. 4, to receive $\frac{1}{2}$ by $5\frac{1}{2}$ -in. carriage bolts. The heads of the bolts must be sunk into the top edge of the rails. Also bore holes through both rails and legs as shown to receive $\frac{1}{2}$ by $2\frac{1}{2}$ -in. bolts.

Now fit the remaining four screw eyes to the legs and drive the corresponding screw eyes in the under edges of the rails as in the side view of Fig. 2. Bore holes in the end of each rail to drop over the dowels which help to hold them in place when the table is folded. Fit springs to hold the legs and the rails after gluing and bracking small pieces of wood to the underside of the top where necessary to receive the springs.

Cut notches across the middle pieces of the end sections to receive the hooks and place springs to hold them there.

If the outside sections are ever folded far back, it may be necessary to cut the cross-pieces of the middle sections away at C to receive the springs. Should the leg hinges bruise the wood at D, cut away the wood neatly. A cloth pocket to receive the bolts may be tacked and glued in place as shown in Fig. 2.

Get out two net posts $\frac{1}{2}$ by $2\frac{1}{2}$ by $12\frac{1}{2}$ in. and place two screw eyes in each to receive the net strings. Fit each post over the edge of the table and

(Continued on page 114)

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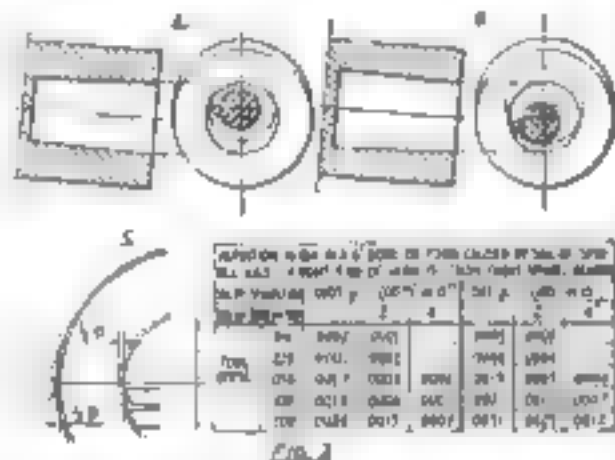
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Turning Oversize Work

(Continued from page 60)

will often be all that is necessary. As has been shown, the bore will be concentric, though tapering, so that the reamed hole will be in line. The right reamer is not always available, however; besides, it cannot always be applied. Therefore it will pay to remember that by having the tool very nearly central in taking the finishing cuts, we will be able to produce a turn or bore which will be very nearly right, in spite of the sag in the axis.

The table at C in Fig. 2 will give an idea of how near the center it is necessary to set the point—or the center of the grinder spindle—to get accurate results. Usually the best way will be to set the tool as near dead center—theoretical spindle center—as possible.

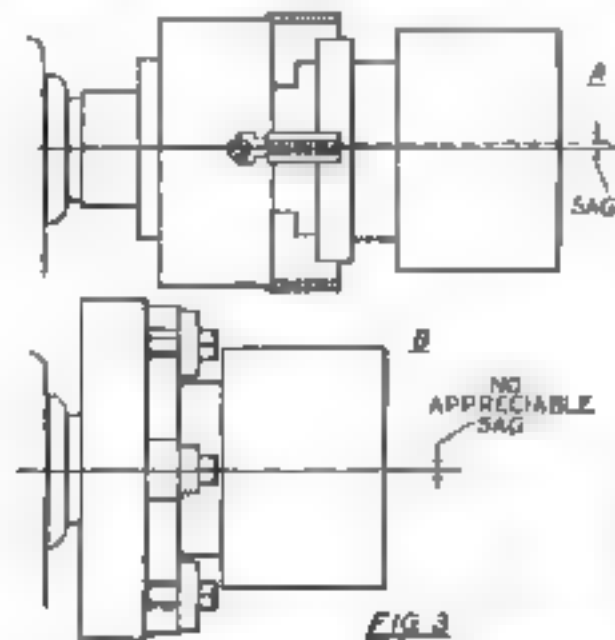


When work is so heavy it sags, set the tool as nearly central as possible for the finishing cuts.

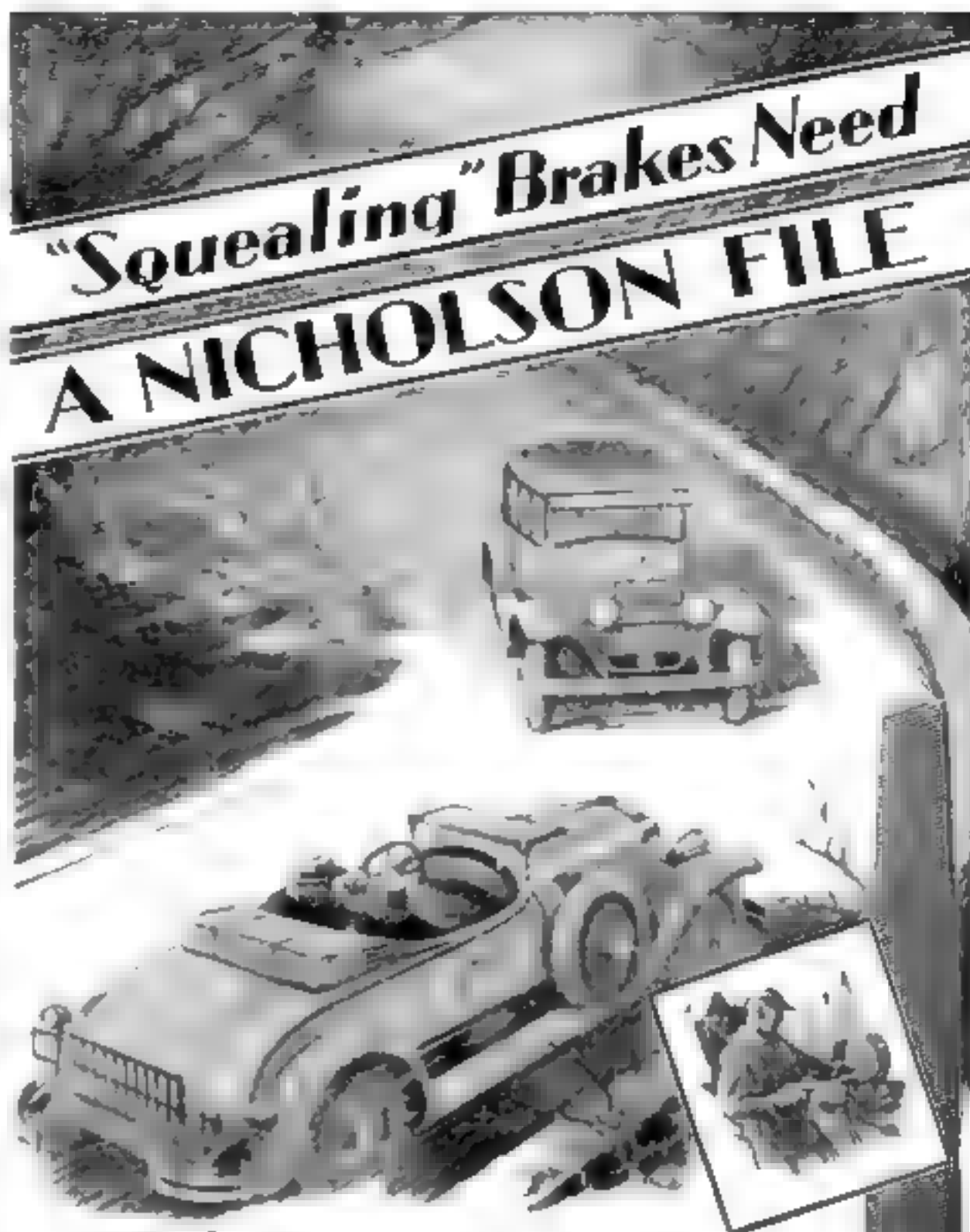
for, although the entire axis of the work is below this line, the rotation of the work has a tendency to throw the point of the tool down and thus even up matters.

Every effort should also be made to prevent sag in the spindle. Sometimes the situation can be bettered considerably by mounting the work on the faceplate instead of holding it in the chuck, as may be seen from Fig. 3. The heavy four-jaw chuck at A sets the work out much farther from the spindle bearing and adds, besides, a heavy weight of its own just where it is not wanted. By substituting the faceplate as at B the weight and its effective leverage on the spindle may be reduced to half and less in many cases. Not only will the likelihood of error be lessened in this manner, but the spindle will often be saved from undue strain.

In some other cases, the steady-rest may be called in to help. Where the work is not otherwise of a shape that will offer a hold, a "stitch" or extension may sometimes be cast on for this purpose and turned off as a last operation. Merely supporting the work in this manner, however, (Continued on page 114)



How sagging sometimes can be reduced by substituting a faceplate for a heavy four-jaw chuck.



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Turning Oversize Work

(Continued from page 113)

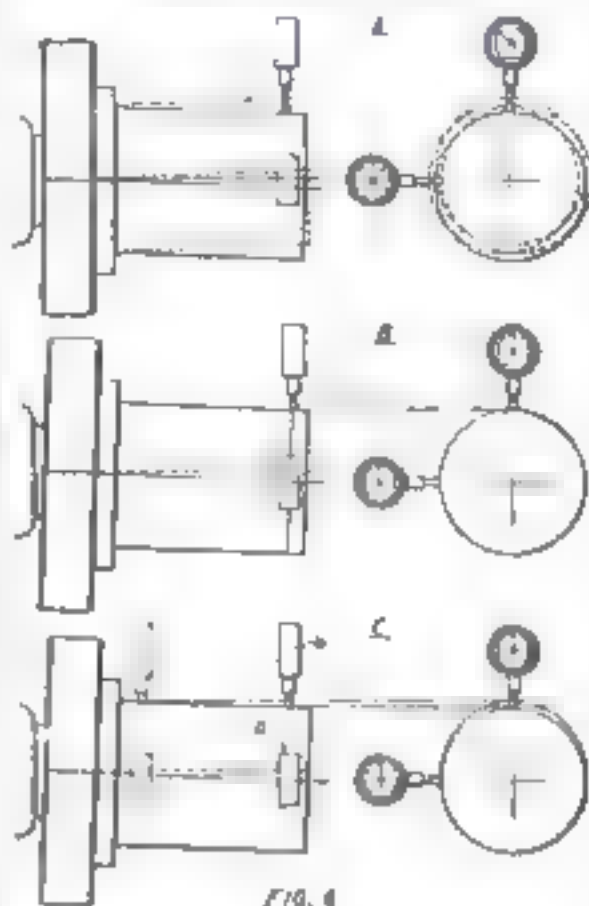


FIG. 4

When you suspect a piece is sagging, run an indicator along either the top or the bottom.

does not do away with the disalignment. Since the spindle sets the moment the work is in place and it is usually difficult to determine the exact amount of sag, there should be some means that will automatically bring the spindle back to alignment.

Figure 1 shows a simple way to solve this problem. The supporting end is first turned to the proper diameter. The spindle is then stopped, a scumming is placed across the front and under the work, and the end weighted down so it will approximately counterbalance the weight of the work—and of the chuck, if one is used. The lever should take hold about under the center of the work, which in the present case is accomplished by sailing a small block on top of the scumming. Where the work is too large in diameter the scumming may be placed below the bed and across a newbuck.

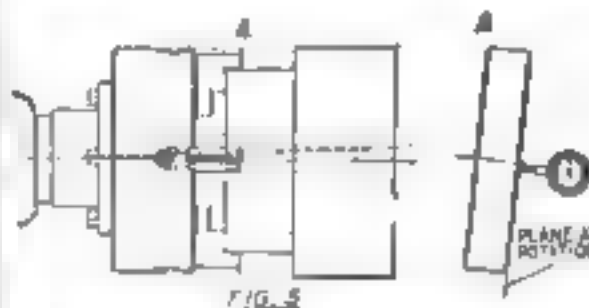


FIG. 5

Diagram to illustrate the bending moment in a lathe spindle caused by a very heavy casting.

placed parallel to the lathe as at B, a long block is being used on the end of the lever to reach through the gap and support the work. With the work so balanced, the steady-rest can be adjusted, the indicator showing if the work sags on easing off the weight, or if it is pushed up while being adjusted.

This is the third of a series of articles on easier and better ways to hold work on lathes and other machine tools. The fourth article is scheduled for early publication. Mr. Simon is endeavoring to sum up in them the results of his own long experience as a toolmaker and machinist and as a designer of machine tools. He is one of the world's foremost writers on machine shop problems.

Timesavers for Shop Men

(Continued from page 84)

more than is necessary. The completed holder can be turned to fit the device in which it will be used. The dimensions given in the cut are for the average diamond, which will be about $\frac{1}{8}$ in. across, and, of course, can be changed to suit the size of diamond to be mounted.

—HECTOR J. C. KAMBERLAND.

IN USING parallels under flat work that has to be milled or ground, considerable difficulty is often encountered either because the parallels slip when the vice is tightened or because they are subsequently jarred loose under the action of the cutter or wheel. The result is only too often spoiled and damaged work.

By spending a few odd minutes to make some spreaders in the shape of thin leaf springs like those illustrated at the top of the third column on page 94, trouble from this source can be avoided. Several spreaders of different width and degree of curvature should be made to take care of work of varying width and height. By making the spreaders of spring brass or bronze, the danger of damage to a milling cutter which might come in contact with them is avoided.

Though it is not necessary to use the "button" shown in the drawing, it is advisable to have it where it is possible to provide the parallels with a small hole through the center. An easy way to obtain the button is to cut a round-headed screw or rivet off just slightly below the head and rivet or solder it in place.

A spreader of this kind is rarely if ever in the way and is almost always a great improvement over using unsupported parallels. The spreaders will also be found useful where a special device, such as a "spuler," is not at hand when lining up short work in the lathe chuck, and it is necessary to resort to parallels.

THERE are various devices for guiding the points of drills. The writer previously contributed a page that shows the concentricity of the point and derives its particular usefulness from the fact that the correct location of the point goes a long way towards insuring the correctness of the cutting angle. On the principle that we usually think of the simplest thing last, the writer now offers a page which, besides verifying the drill size, at once shows the concentricity of the point, the truth of the cutting angle, and the clearance.

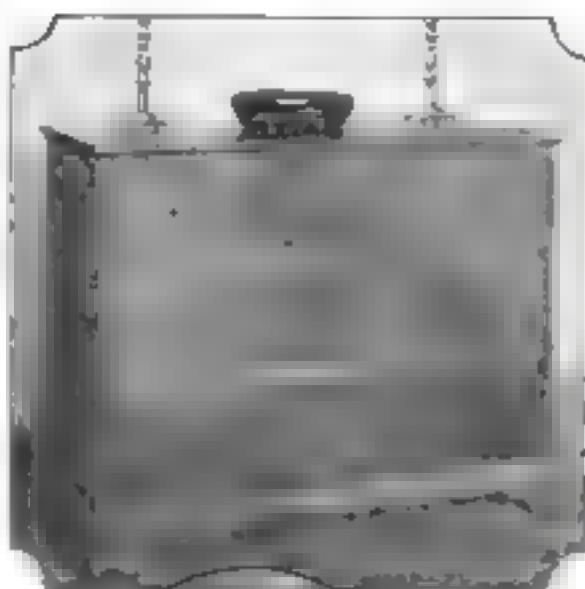
This truly universal page is a little more work to make than other devices, but, even so, it is simplicity itself, and the combination of advantages it offers will recommend it.

As will be seen from the lower right-hand illustration on page 94, a row of holes is carefully drilled in line in a piece of flat stock, then one half of the stock is milled away over the ends of the holes to expose the cross section. Every element entering into the point design then can be checked at once.

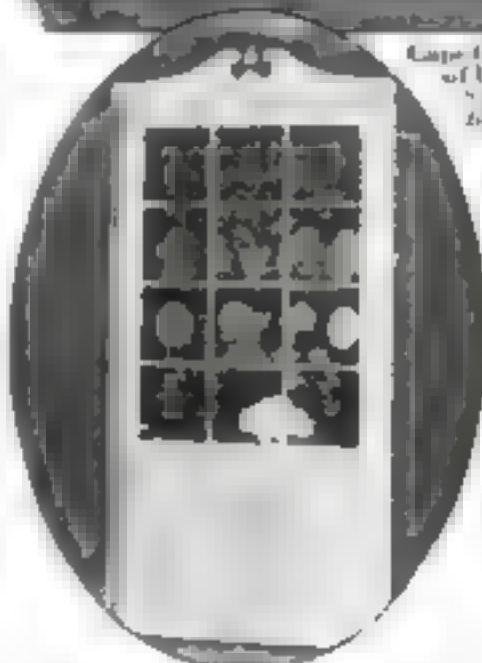
The page can be made from 8 to 4 in. long, the width and thickness being controlled by the size of the drills. The particular page shown is $3\frac{1}{2}$ in. long, $\frac{3}{4}$ in. thick, and $1\frac{1}{2}$ in. wide, and accommodates drills from $\frac{1}{8}$ to $\frac{1}{2}$ in. inclusive by thirty-seconds. For small drills, as many as a dozen and a half sizes can be accommodated in a page of similar length.

The main things to watch are getting the holes all in line and straight, and finishing each hole with a drill freshly ground exactly to the right shape. While it is not necessary to have the page hard, it will pay to make it of non-shrinking tool steel and heat treat it; this will also give it the desirable dark color.

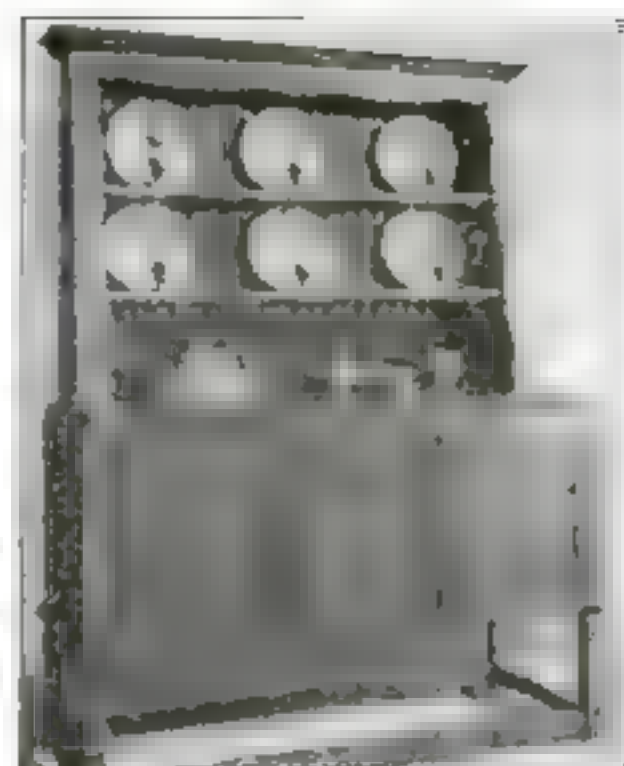
At A is shown a drill slightly off on one cutting lip. From the same view it will be plain how the clearance may be ascertained by turning the drill slowly to the right. If the space between the lip surface and the edge A of the page steadily increases as the drill is turned, the amount of clearance is plainly seen, as are also any spots on the lip surface that are too high or too low. —HENRY SIMON.



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Plymouth Built-in China Cabinet
See LePage's Book, page 6



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Turning Rings of Wood

(Continued from page 76)

edge. Alternate with a $\frac{1}{4}$ -in. skew chisel, which should be held so that it cuts with the toe (see Fig. 3, page 114, Oct., 1928, issue). Test the diameter of the hole with a pair of inside calipers. Then round the edges and sandpaper the work.

The dead center should now be moved up again, so that its point bears against the wood at the bottom of the hole just cut. This added support is needed for cutting the first napkin ring away with the parting tool. The remaining one is then bored and cut off in the same manner.

The remaining end of the 6-in. piece is now turned until it is equal to the diameter of the holes which have just been cut halfway through the two napkin rings. The length should be a little less than the depth of the hole, so that the napkin rings will butt up against the square shoulder formed on the piece as in Fig. 2.

WHILE turning this chuck, try the fit of both napkin rings frequently, because the hole cut in one napkin ring is likely to be slightly larger than the hole cut in the other. Finish the larger one first and then cut down the chuck to fit the smaller one. Do not force the rings too tightly on the chuck or they may split.

Bore the other half of the hole in each ring as explained above. Then stain and polish the rings.

When a ring having a circular cross section is to be turned from a solid piece of wood, the stock, after being faced off, should have the same thickness as the diameter of the cross section of the ring, as indicated in Fig. 4. A piece of $\frac{3}{4}$ -in. plywood is placed between the screw chuck and the material to be turned and prevents the screw in the chuck from penetrating the $\frac{3}{4}$ -in. disk.

After facing off the disk and turning it to the required outside diameter—in this case 2 in.—it is cut down as shown in Fig. 4. The square corners are then cut off (Fig. 5), after which the ring is rounded as shown in Fig. 6.

A template may be made of a piece of strong cardboard or veneer about 8 in. square. Proceed as follows: Draw a straight pencil line about in the center of the piece of cardboard. Tack it to a piece of wood, place the screw of an auger bit of the desired diameter—in this case $\frac{1}{2}$ in.—on the center line, and bore a hole. Cut on the line with a knife, thus dividing the cardboard in two pieces. Use half of it as a template (Fig. 7).

CHUCK the partly turned ring as shown in Fig. 8. The wood used in making the chuck may be soft, and it is well to have it thick in case the recess cut in it should be too large; in that case it may be faced off again and another recess cut. The center is now cut away and the turning of the ring completed.

Such rings may be used for the hanging of curtains or portieres, or as towel or necktie rings. A necktie holder is shown in Fig. 8. It fits into another turned piece, which is screwed to the wall or to a closet door.

A small section is cut out of the ring, thus permitting it to be sprung a little and slipped into a hole bored in each side of the turned piece. The center of these holes is found by wrapping a strip of paper $\frac{1}{8}$ in. wide around the piece. Cut the ends of the paper so that they just meet. Remove the paper and fold it once in the center. Draw a pencil line lengthwise through the center of the paper, wrap it again around the wood, and prick a hole on the center line where the ends of the paper meet and another where the pencil line crosses the fold (Fig. 9). Bore these holes while the turned piece is in the lathe and before the ends have been cut off.

A towel ring

(Continued on page 118)



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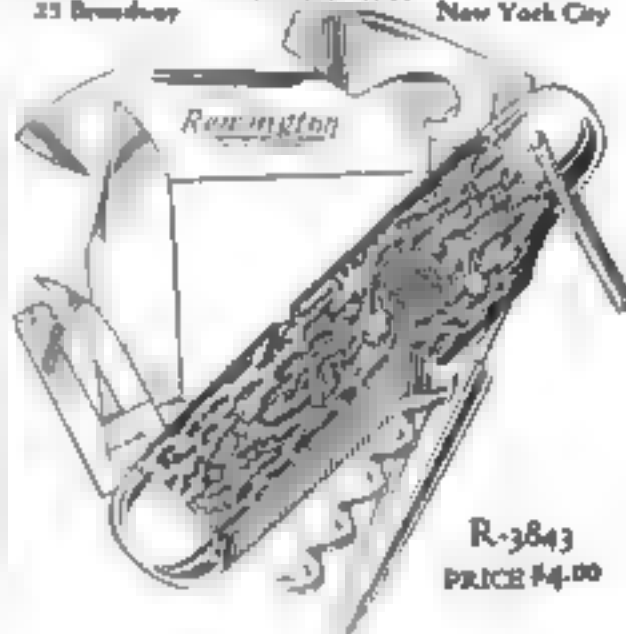
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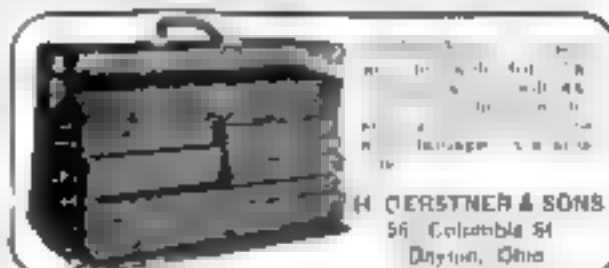
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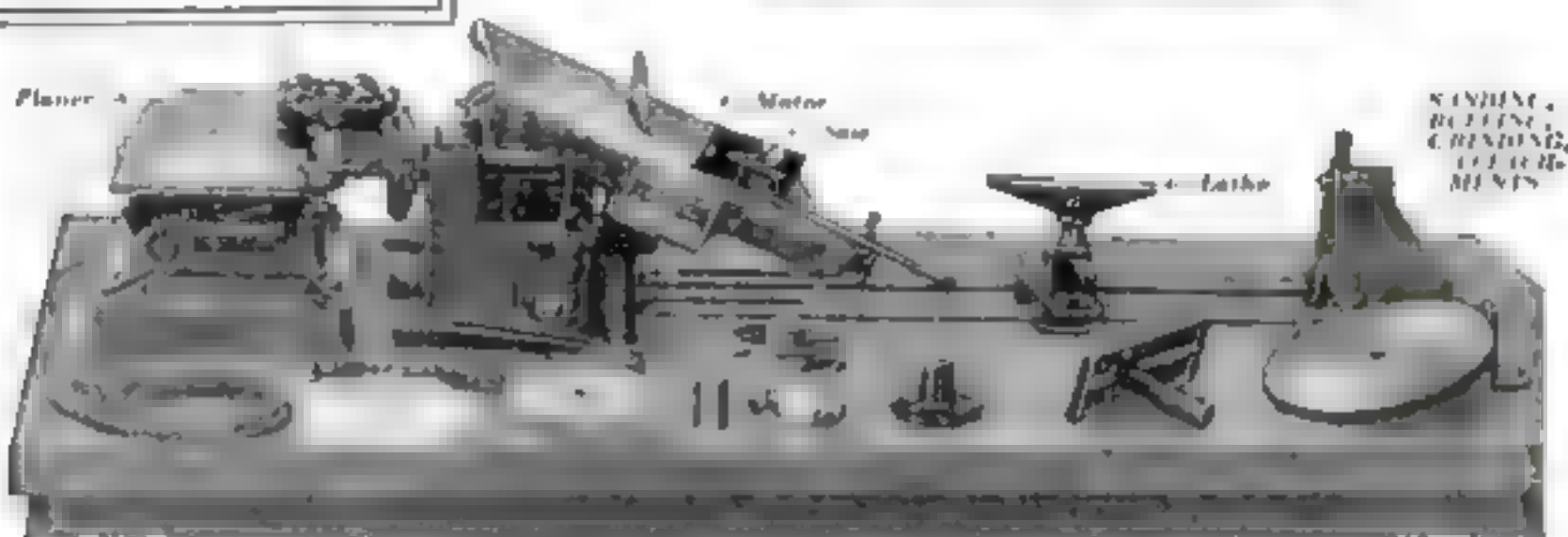
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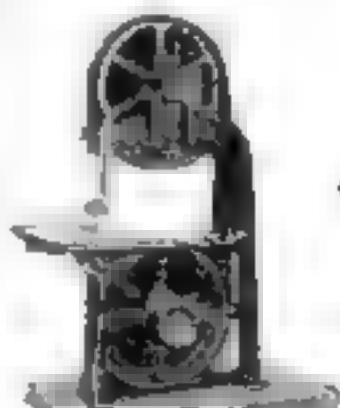


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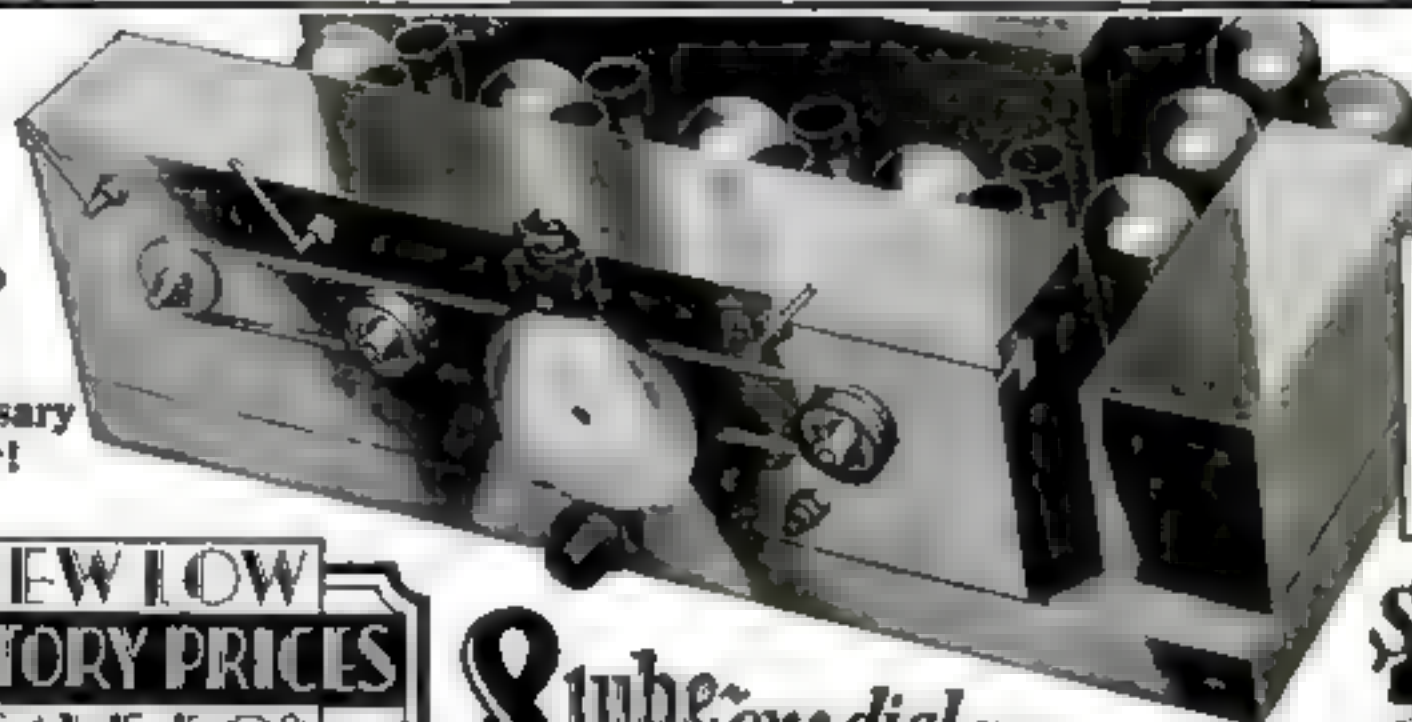
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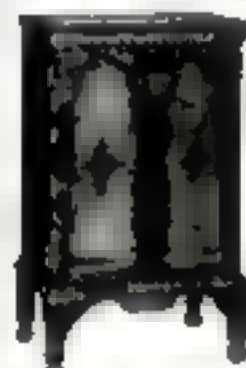
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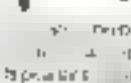
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Model Railway Control

(Continued on page 121)

train from going too fast and being wrecked.

The double-pole switch is wired as shown in Fig. 3. Check this wiring and you will find that when the switch is thrown to one side, the full voltage is supplied to one grade, and the voltage to the other grade is reduced by a rheostat that can be adjusted for down-grade running. This rheostat is shown on the control panel just below the double-throw switch. A train running around the track strikes the up-grade and receives the full voltage while it is climbing. When it strikes the down-grade, the voltage is automatically reduced.

You do not have to make any hand adjustments on account of the grades, even if two or more trains are running on the track at the same time. Of course, if one train is faster than the other, you will have to stop the faster train at intervals to prevent it from overtaking the slower train. But if your railroad is equipped with an automatic block system such as was described in the December, 1926, issue of POPULAR SCIENCE MONTHLY, page 70, the trains will require no attention whatever.

THE double-throw switch is provided so that you can reverse the voltage control to the grades when you desire to operate a train in the opposite direction.

The voltage changing switch on a small transformer necessarily must be made so that the current will be cut off between switch points. The automatic reversing locomotives are of the sequence reversing type. Each time you cut off the current and turn it on again the locomotive starts in the opposite direction. Therefore you cannot change the voltage while the train is running unless you stop and start it all over again. This is rather awkward when you want to increase the voltage to take care of an additional train.

There is, however, a way to overcome this difficulty and the remaining switch on the control board accomplishes this result. Near the lower right hand corner (Fig. 3) you will note a small lever projecting through the board. This is a standard type two-way electric light switch of the toggle variety. The usual metal plate has been left off because it would spoil the appearance of the board.

The wiring is shown in Fig. 4. In one position current for the track is obtained from one transformer terminal, and in the other position current is obtained from a higher voltage tap. The secret of this switch is that it snaps from one position to the other so rapidly that the reversing mechanism in the locomotive has no time to operate and the train continues in the same direction with no apparent break.

This switch, plus the rheostats for minor variations, will permit you to obtain a wide range of control. Figure 4 shows the underside of the control panel. Ordinary bell wire is used throughout.

As supplied by the manufacturer, each electrically controlled switch has a three-wire cable leading to it from a flat type two-way switch. The white threaded (Continued on page 121)

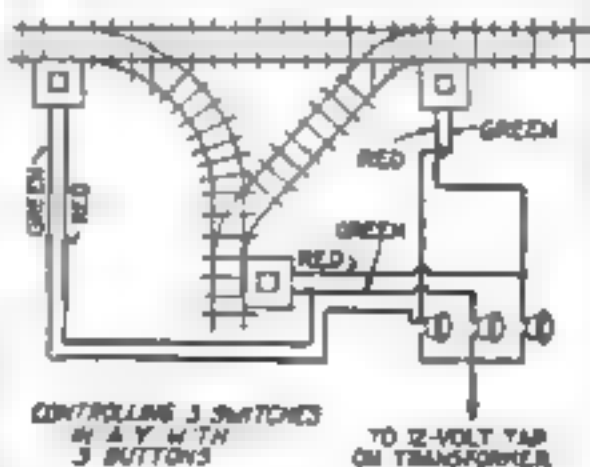


Fig. 4. How the three switches of a Y are controlled as a group by the three push buttons.

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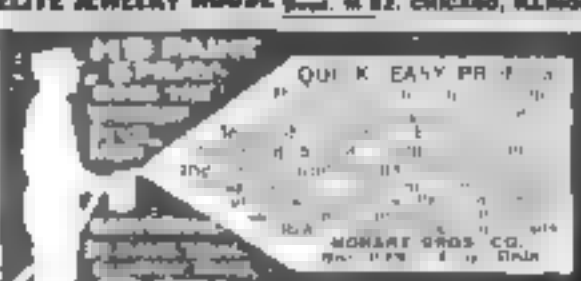
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Model Railway Control

(Continued from page 109)

wire of the three connects the arm of the switch to the third rail. The green and red threaded wires connect the contacts of the switch with one end of each electromagnet, the other wire from each electromagnet being grounded on the running rails of the switch.

In wiring the switches for push-button control, you may disregard the white threaded wire and extend only the green and red threaded wires to the control board. The wire that supplies current from the transformer to the third rail by way of the toggle switches can also be connected to one side of each of the switch control buttons. The remaining terminals of these buttons can be connected to the red and green wires from the switches.

IF YOU install independent control for each switch, you will need two buttons for each switch, but a group control will save buttons and prevent mistakes in operation. The proper grouping of the switches will depend on your track layout, and a little study will be required to determine the best arrangement.

As an example of what may be done in this direction, examine Fig. 6, which shows in picture diagram form the simplest connections for a Y. (One button is connected to the green wires from the two switches on the main line. The second button is connected with the red wire from the left hand main line switch and the green wire from the Y switch. The third button applies current to the red wires from the Y and right-hand main line switches.

Pressing the first button clears the main line, no matter how the switches were set before the button was pressed. A touch on the second button sets the switches for a train going out to the left or coming from that direction. The third button allows trains to travel over the Y to the right.

Similarly, two buttons will control the two switches that are used in a crossover, and in the terminal you can provide one button for throwing all the switches to clear the track to the last siding and have individual buttons for controlling the other positions of the switches along the track that lead into sidings nearer the main line.

Weatherstrip for Bottom of Storm Door



STORM DOOR

Storm door with a doubled piece of inner tube applied to keep it weather-tight at the bottom.

HINGED weatherstrip with a rubber edge, such as is often fastened at the bottom of a storm door, is apt to be more ornamental than effective, but a weatherstrip may be made of an old inner tube that will accomplish all that can be desired in keeping out wind, rain, and snow.

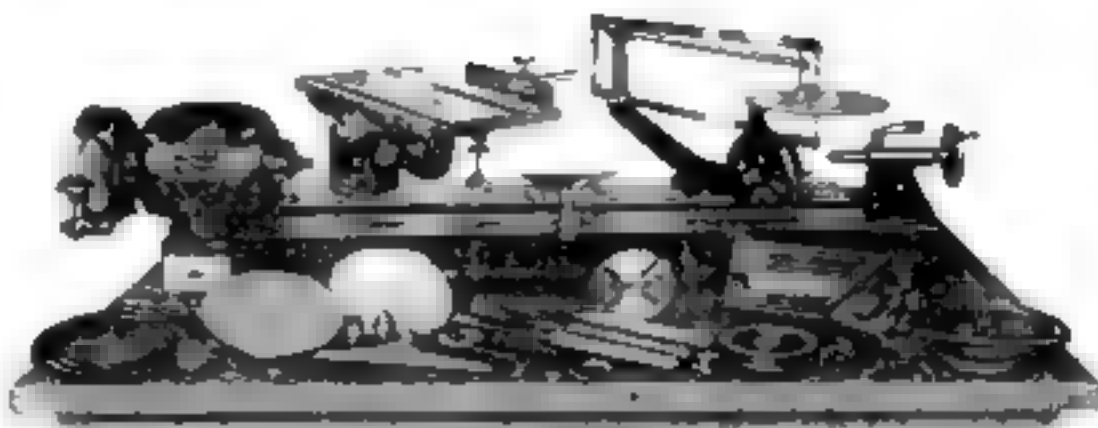
Be sure the bottom of the door clears the threshold by $\frac{1}{4}$ or $\frac{1}{2}$ in. Prepare a piece of board $4\frac{1}{4}$ or 5 in. wide and the width of the door opening in length, to be used as a pattern. Cut a piece of old inner tube lengthwise and spread it open, flat and straight, upon a board, fasten it lightly with tacks, without stretching. Lay the pattern upon the tube and with a sharp knife cut accurately around the board.

Fold the rubber lengthwise in the middle and touch it lightly with cement an inch or two each side of the fold, but not near the edges, to hold it together while it is being tacked to the inside of the door.—C. A. K.

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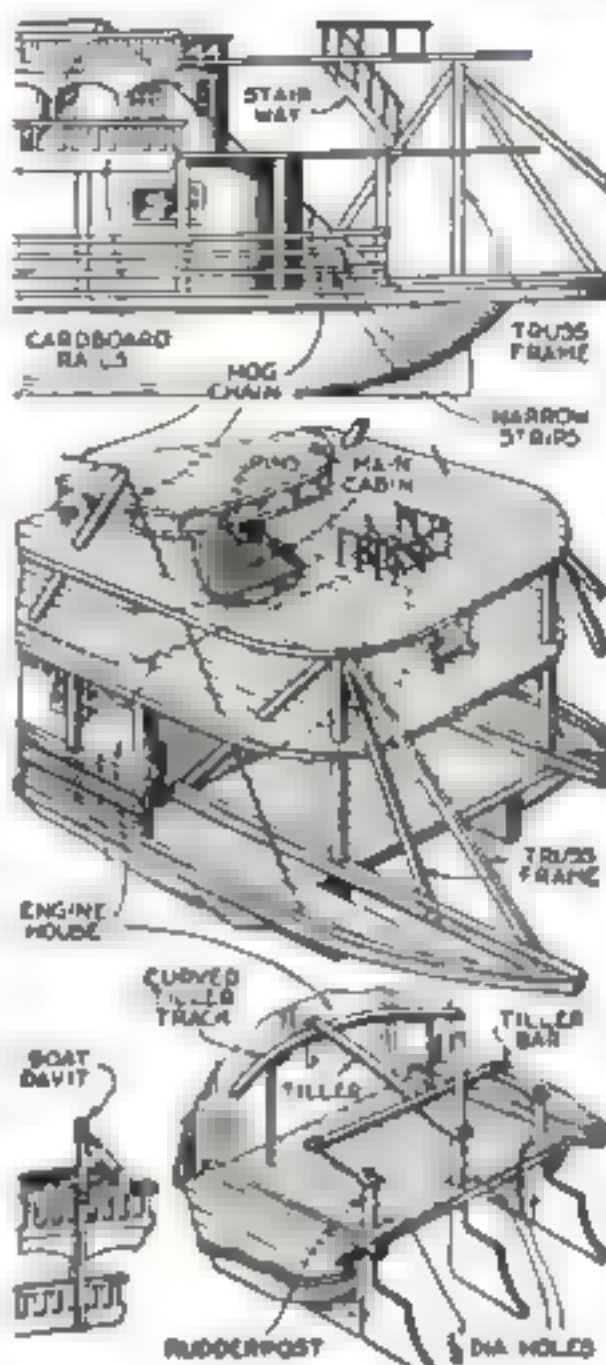
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Address _____

Building the Buckeye State

(Continued from page 92)



Fittings at the stern of the model, including trusses, hog chains, ladders, rails, and rudders.

lower and upper handrails and where the edge of the upper deck comes. Apply a similar piece inside along the top edge.

If the weather is very humid, these pieces will have to be dampened by rubbing them with a moist cloth before they are applied; otherwise, however well glued on, they will buckle in damp weather.

Glue them on and hold them in position until dry with glass-headed pins (these are sharp and easy to handle). Along the inside of the upper part—and the lower, too, if you wish—some thin strips of wood from the rail to the deck will look well and stiffen the whole. Give the whole one or two coats of flat white paint and a coat of white enamel.

NEXT should come the deck on the cabin, which is similar to the other decks and projects a full $\frac{1}{4}$ in. all around. Also put on the telex because its bulk can be easily grained and will save the handrails and other delicate parts from damage in handling the model.

The telex of my model, as shown in the upper photograph on page 92, has not as many windows as it might have because I had doors between and then found when all was finished that there would have been no way in which anyone on board could reach them, so had to cover them up.

The telex can be made by either of the methods described last month, but preferably by the built-up method, which leaves it hollow. The lines of its sides will coincide with the

side lines of the cabin. It is round in front square abaft. There should be two doors abaft for entry. It will have a deck similar to those below.

The hog chains (Main Chains No. 2) should now be fitted. For the after strut bore through both decks into the top of the engine room, paint the strut black, and glue it in position extending above the upper deck $\frac{1}{2}$ in. For the forward one we already have holes in the lower decks, make another in the upper in line with them and put it in position to extend only $\frac{1}{2}$ in. Bore holes for the wires, then rove the ends down through. Turn up the forward end of each and drive it into the hull, stretch it over the struts, draw it down tight aft, and turn the end up. Do this on both sides, of course.

PLACE the forward and after ladders in position. The forward ones need handrails on the outside only. The after hole needs a guardrail on three sides, but the forward ones, where the deck is so narrow, need be guarded on only two sides. Note that the side supports of the forward guardrails are on the top of the cabin and are shorter than the posts which extend from the upper deck.

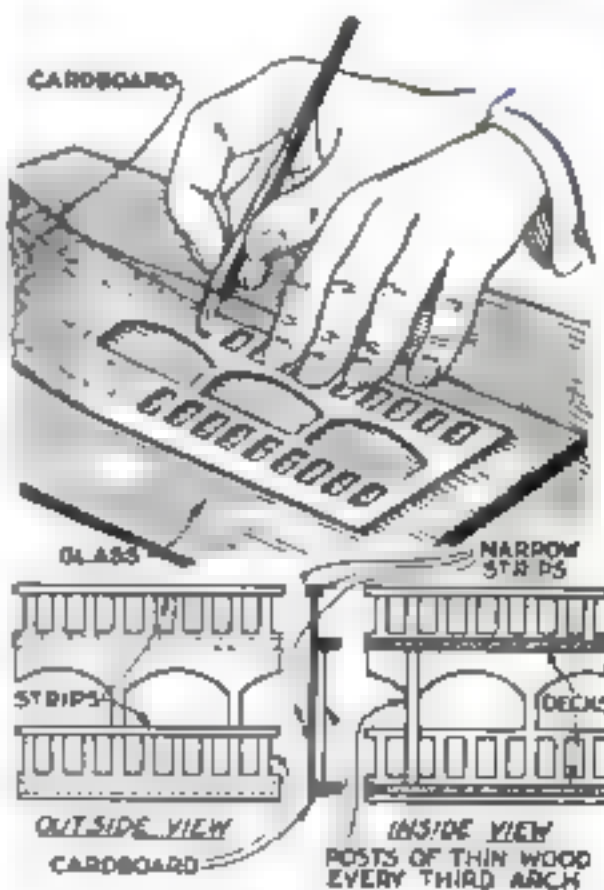
In the original model the upper ladder handrails are of brass wire and the lower of wood.

We have yet to put the four slanting cross timbers on either side between the lower decks. They extend from main to boiler deck and are similar to the lower stanchions, they are nailed outside all. Their positions are shown clearly on Blueprint No. 96 and in the upper photograph on page 92.

The boat davits, which also are shown on Blueprint No. 96, may now be put in position. They are merely square posts, glued to the deck edges outside everything else and perhaps lashed with thin thread to the upper handrail. They have the smallest possible double blocks lashed to their upper ends on the outside. These and the lower stanchions should be painted white. The lowest handrail may be white or mahogany color.

Before we build any higher we had better make and fit the rudders and stern wheel.

There are three rudders moving in unison, as shown in the drawing. (Continued on page 124)



The Bristol board rails are prepared in two long pieces, one for each side of the model.

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The Buckeye State

on page 122. They must be accurately fixed so that they will be almost in line with the boat's bottom and allow the wheel to turn in their curve. They can be of wood or metal, the former being the easier to use. They had better be in one piece with their posts. Note that the outside posts are short, but the center one extends just through the bauler deck, because that rudder has no support under the main deck.

Into each sternpost drive eyes made of pins, and into the outside rudders drive and bend over pins to fit in the eyes. For the union gear make three tillers: one long with two holes, and two short with one hole in addition to the necessary square holes which fit tightly on the rudderposts. The tillers can be made of sheet tin or copper. Join the three with a bar having holes which correspond with the distances between the holes for the rudderposts. Rivet the bar to the tillers with crutchpins or large pins.

Pass the rudderposts through their holes and set the tillers on them at an upward slant so that the center tiller runs on the railway previously installed.

Set the pintles in the rudders into their gudgeons in the sternposts and drive a pin through the center rudderpost above the deck to prevent it from dropping lower than the others.

The wheel and remainder of the fixtures will be described next month.

Mississippi Books

ADDITIONAL information about Mississippi steamboats and many facts about the dramatic history of the Valley can be gained from the books listed below. The list was prepared by Captain McCann during the careful study he made of the literature relating to river steamships. He found particularly interesting and valuable the books that are starred. Those volumes which have the price indicated can be obtained through the Book Department of **POPULAR SCIENCE MONTHLY**, the others, the majority of which are out of print, are available in many public libraries.

American Steam Vessels, Samuel Ward Planton.

Chronological History of Steam Navigation, A. G. H. Preble.

Down the Great River, Willard Glazier.

Early Western Travel, Hubert G. Thwaites.

Early Steamboat Travel on the Ohio River, Leslie S. Henshaw.

Fifty Years on the Mississippi River, Emerson W. Copeck.

Genesis of Steamboating on Western Rivers, Gen. Byron Merrick.

History of American Steam Navigation, John H. Morrison.

Life on the Mississippi, Mark Twain (\$2.50).

Life on the Western River, John Halberstadt.

Mississippi River, The, Julius Chambers (\$3.00).

Mississippi Steamboats, H. and E. Quick (\$3.00).

Old Times on the Upper Mississippi River, Gen. Byron Merrick.

Progress of Navigation and Commerce on the Mississippi and Great Lakes, John W. Mortwell.

Steamboat Days, Fred Irving Dayton (\$3.00).

Father Mississippi, Lyle Saxton (\$3.00).

A-Rafting on the Mississippi, Charles Edward Russell (\$2.50).

The Romance of the Rivers, John T. Farris (\$3.00).

Steam Boat, Edna Ferber (\$2.00).

The last four books are comparatively recent, and so great is the present interest in Mississippi steamboating that other books are certain to appear. The above bibliography does not pretend to completeness, but offers a fairly wide field for further study.

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"Don't make a monkey of yourself"

cried Bob as

I sat down at the piano

BOB was always putting his foot into things.

I was spending my vacation with him when I met his cousin, Helen. Instantly all other girls faded out of my life. It was love at first sight. But unfortunately she didn't seem to feel the same way about me.

I like all young lovers, I confided my troubles to the nearest willing ear. It happened to be Bob's.

"You've got nothing to worry about," he insisted when I finished my tale of woe. "Just leave it to me. All you need is a little publicity."

Right then and there I knew I should have kept my mouth shut.

The very next day he announced that he'd just had a long talk with Helen and according to him, "put me over big."

"Hoy! What I didn't tell her about you is nobody's business!" he exulted. "When I got through with my little song and dance about what a whiz you are at the office, I pulled my trump card . . . and believe me, it boosted your stock sky high!"

"What was it?"

"Well, you see, she's crazy about music. So I conveniently forgot that you can't play a note, and told her you are an accomplished pianist!"

"But Bob . . ."

"Not another word! I've got you sitting pretty, now. If by any chance you're asked to play—just say that you've sprained your wrist playing tennis. I'm some little fixer, eh, what?"

That very night we were all invited to the Carsons' party. On the way over, I sensed a big difference in Helen—a difference that made my heart beat fast with a new hope. Perhaps, after all, Bob was a good fixer.

A little later in the evening we were all gathered around the piano, listening to the rather indifferent performance of one of the guests.

I Am Asked to Play the Piano

"I'm just dying to hear you play!" cried Helen. "I've heard so much about your talent! Won't you play something for us?"

"Yes!" "Yes!" "Please!" came from all sides.

With a smile I bowed low . . . and replied that it would be a pleasure.

Glancing up I saw Bob's grin change to amazement. This was not part of the plan! Calmly ignoring his frantic signals I walked over to the piano.

Quick as a flash Bob followed me. "For the love of Pete get away from that piano," he whispered excitedly. "Don't make a monkey of yourself. If Helen ever hears you play she'll think everything else I told her is bunk, too!"

Turning to the guests in an effort to save his own skin, Bob announced, "Perhaps we should wait until some other time. You see, his wrist was slightly sprained in tennis this afternoon, and . . ."

"Oh, that's nothing!" I broke in, and as he looked at me dumfounded, I sat down at the piano.

Without any further hesitation, and with a secret smile at the surprise I had up my sleeve, I began the



first notes of Irving Berlin's famous "Russian Lullaby!" The tantalizing, irresistible strains seemed to throw a spell over the guests. One by one they quietly moved nearer the piano until soon I was completely surrounded by rapt listeners.

Bob was so stupefied that all he could do was to stand there in open-mouthed amazement.

On and on I played—losing myself in my music. I forgot Bob's astonishment—forgot the glow of admiration in Helen's eyes—forgot everything but the beautiful melodies that always opened a new world for my exultation. Swept away by the sheer magic of Berlin's genius, I was unaware of the silent tribute that followed my playing until thunderous applause shook the room.

That brought me to myself with a start. For the rest of the evening I was the lion of the party.

Bob could hardly restrain his curiosity until we were safely home.

"Boy! You sure stopped that party dead!" he exclaimed. "You could have knocked me over with a feather when I heard you actually playing! Why didn't you tell me you knew how?"

"You never asked whether I knew how to play," I countered.

"Of course not! Last summer you didn't know one note from another—how was I to guess you'd

blossomed into an accomplished pianist overnight?"

"Not overnight exactly!" I smiled. "Although it almost seemed that way! Remember that Free Demonstration Lesson in music I sent for?"

"You don't mean the one that was supposed to show you how to play without a teacher, do you?"

"The same! All the fellows said it was a fool stunt and that I was crazy to send for it. Well, it happened to be the best bit of luck that ever came my way! I didn't say anything about it because I didn't want every one laughing at me when I sent for the course. That course certainly is wonderful!"

"So you really are an 'accomplished' pianist! The joke's on me, all right."

"Oh, I wouldn't say 'accomplished,'" I laughed. "But enough of a pianist to get a lot more fun out of life than I used to!"

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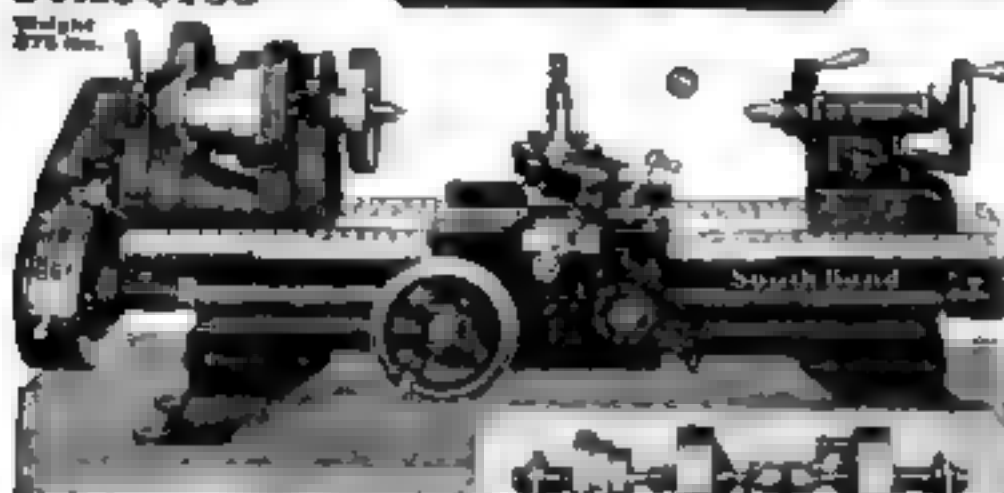
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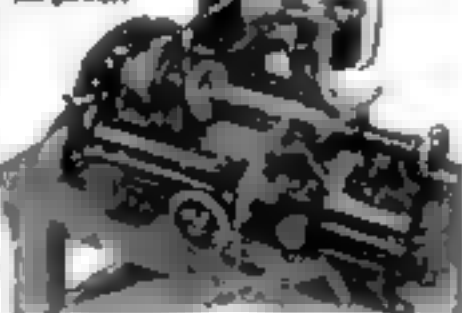
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Tools from Theft. Write with Arkograf on tools and designs on the front and back of tools and instruments, or on metal, like knives on paper with pen or pencil. Complete Detail 52-53 Presidio Apartments, Berkeley (Illustration of a tool with a keyhole).

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HESTON & ANDERSON
302 Market Street, Fairfield, Iowa

Decorative Metal Sawing

(Continued from page 76)

blade should be straight up and down. When you come to a corner or sharp angle, do not push the saw forward at all, but turn the saw frame slowly as you move it up and down. The saw will cut a hole for itself to turn in; then you may resume sawing in the usual way.

On some types of work much time can be saved by drilling holes for the saw to turn in at all sharp angles. It is always necessary, of course, to drill at least one hole in each interior part which is to be cut out. The blade is inserted through the hole after being loosened at one end from the frame.

If you rub a lump of beeswax or a candle on the blade at intervals, it will help the sawing. Brass is probably the metal easiest to saw, but silver and gold are both excellent. Copper tends to cling to the blade.

Very thin metal such as No. 28 or 30 gage is best fastened with shellac to a piece of

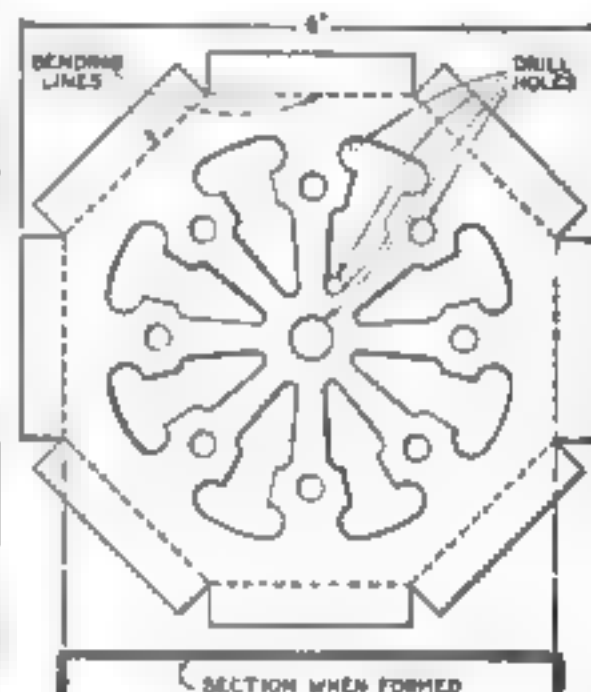


Fig. 3. How to lay out the design for the teapot stand on a piece of brass 8 in. square.

card-box wood or even thick pasteboard. Later the metal is removed from its backing by heating it. Very thin, fine-toothed saws must be used for such delicate work.

After practicing on scrap metal the beginner can make the teapot 'tile' or stand illustrated in Fig. 4. Brass is the best metal to use.

First draw the design as in Fig. 3, or, better still, make up a simple design of your own of the same type and then transfer it to a piece of No. 18 gage clean flat brass. Scribe in the lines.

The eight-sided shape may be cut out with a pair of stout metal shears, but it is excellent practice to saw to the outline. Drill a hole in each interior part and remove any roughness left by the drill on the underside of the metal. Next saw out the design; then file the cut edges on the bench pin as shown in Fig. 2 using small needle files and larger half-round or crowing files, which have very fine teeth.

Leave no raw edges; all must be well rounded or chamfered. Fairly coarse, followed by fine, emery cloth, if torn into narrow strips, may be used to smooth down the edges after they have been filed. For this work hold the tea stand between the vise jaws, but place paper to protect the metal from the jaws.

The edges may be turned down over a clean-cut block of wood held in the vise as in Fig. 3. Do the hammering with a wooden mallet. The corners of the bent-over parts do not need to be soldered. Polish or finish the piece in any way you wish.

Many similar projects, such as blotter corners, paper knives, and watch fobs, may be made in the same way as the tea tile.



Fastening Objects to Plaster Walls

Paste this Home Workshop Reference Sheet, including the head above, in your scrapbook in the section marked walls. (Feb., 1929, POPULAR SCIENCE MONTHLY.)

How do you drive nails in plaster walls?

Nails will hold in plaster walls only when driven right through the plaster into one of the wall studs, or uprights, to which the lath is fastened. To find one of these uprights, tap the wall very gently with a hammer and listen to the sound. The sound is hollow in tone except where the studs are located, and there is a perceptible difference in the rebound of the hammer.

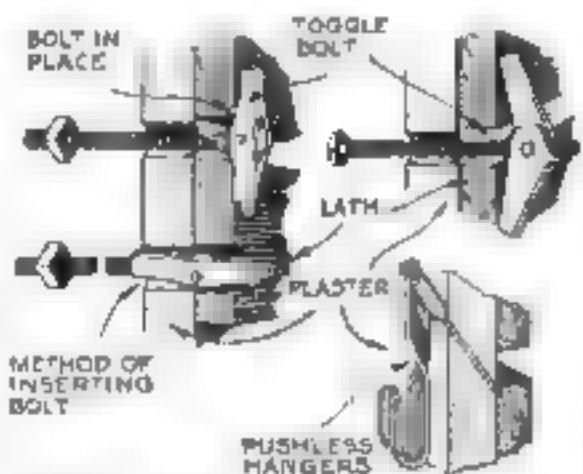
If you find it to be difficult or impossible for you to detect these differences, look at the baseboard and note where it has been nailed. The nails are driven into the studs, and there is usually good nailing at any point in a vertical line directly above them. Drive a thin finishing nail carefully through the plaster to make sure that the stud has been located.

Studs ordinarily are placed 16 in. from center to center; you can, therefore, locate other studs by measurement after the first is found.

If large nails are to be used, drill holes through the plaster so that it will not be chipped. Use an ordinary twist drill, fluted drill, or gimlet bit.

How can something be fastened to a plaster wall at a place where there is no stud to give good nailing?

1. Obtain a toggle bolt (see the illustration below) of suitable size and drill a hole to receive it. Plumbing fixtures, clocks, shelf brackets,



Toggle bolts for use in plaster or other hollow walls, useful hook for plaster or wood.

and other articles of considerable weight may be fastened with toggle bolts.

2. Light objects, such as pictures or mirrors, can be hung by means of the hooks or "pushless" hangers shown, which are sold in various sizes according to the weights they are intended to support. These may be used anywhere, without reference to the studs behind the plaster. Drive the pins carefully, especially the larger sizes. (Continued on page 128)

Big Savings on LATHES

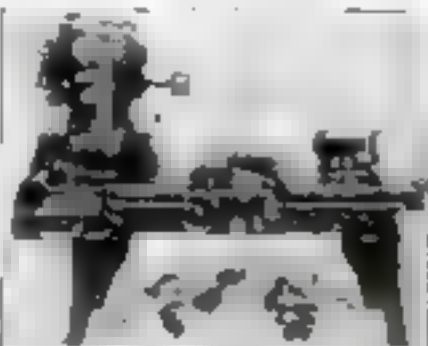
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18"x24" Junior Back Geared Screw Cutting Precision Lathe. Has power feed to carriage compound rest. 3/4" hole through spindle and phosphor bronze spider bearings. Also made with 3, 3 1/2, 4, and 4 1/2 inch beds. Weight 750 lbs. Complete with Countershaft and Equipment. Price **\$150**



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Where's the can of PLASTIC WOOD?

(Reg. U. S. Pat. Off.)

What if a fixture has pulled out—and towel racks, glass holders, and other fixtures set in tile do come loose?—it is easy enough to fix them permanently with Plastic Wood. Just clean the hole to remove loose plaster, wood, or dirt and fill it up with Plastic Wood—the amazing household product that handles like putty and hardens into solid wood. Then, when hard, screw the fixture back in place—or, if it has no screws, “set” it while the Plastic Wood is still soft.

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It comes in two forms—Plastic Wood, of natural wood color, and Plastic Wood White Waterproof Tile Cement, which dries to a hard flat white, and is particularly useful around loose tiles and other places in a tiled bathroom where a white finish is desired.

Plastic Wood is waterproof, greaseproof and weatherproof. It has a thousand uses indoors or outdoors, and for the handy man it helps in almost any wood-working job for sealing joints, filling cracks, moulding, or repairs.

Plastic Wood Solvent

When working with Plastic Wood, keep a can of Plastic Wood Solvent on hand to soften it if it hardens too rapidly, to thin it if necessary, and to clean the hands and tools after using. At dealers, in 25 and 50 cent cans.

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1 lb. \$1.00 ¼ lb. 35 cts.

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ADDISON-LESLIE COMPANY

312 Bulwer Street

Coscon, Mass.

Plaster Wall Fastenings

(Continued from page 127)

to avoid chipping the plaster. Indeed, it is better when the larger sizes are used to take the pains to drill holes at the correct angle for them.

To drive one of the pins, first withdraw the pin until the hook can be held firmly against the wall; then drive the steel point home.

How do you drive screws in plaster walls?

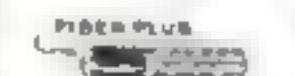
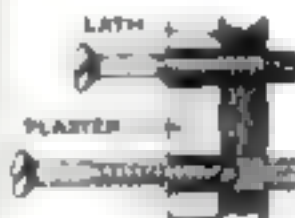
1. Locate the stud behind the plaster as previously described and drive a 1½ in. long screw through the lath and plaster into the wood. It will penetrate the stud about ¼ in., which is usually far enough to hold any ordinary picture or other object. Before driving the screw drill a hole through the plaster of a diameter equal to the unthreaded part of the screw and a hole in the stud a trifle less in size than the root diameter of the threaded portion of the screw.

2. When an stud is to be found in the position desired, use a toggle bolt as described in the first answer to the previous question.

3. Drill a hole in the plaster just large enough to receive a prepared commercial fiber plug of the kind illustrated. This has a small hole through the center into which the screw is driven. The fiber swells and binds the screw tightly in plaster, tile, cement, stucco, and similar materials.

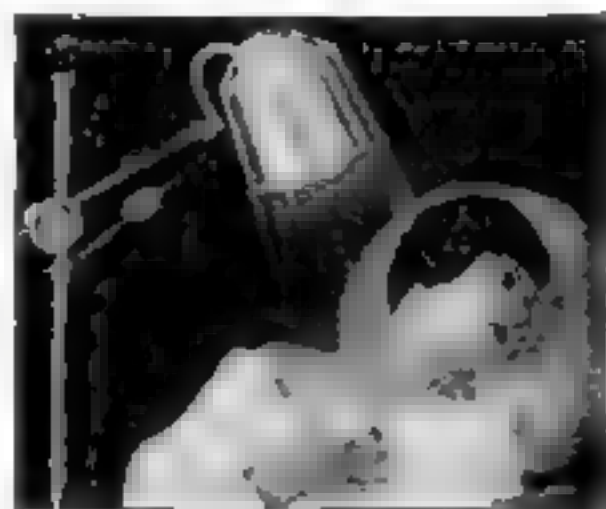
4. Between studs it is often possible to drive a 1½ in. screw so as to take good hold in a wooden lath. Such a screw will usually hold surprisingly well, but sometimes it will fail. A toggle bolt, mentioned in paragraph No. 2, is far stronger.

5. For very light work a hole can be drilled in the plaster a little larger than the screw and filled with patching plaster or plaster of Paris and water. Turn the screw gently into the soft filling and with a knife smear down the plaster around the screw. If it is desired to have the screw removable, the threads should be wrapped with copper wire and bolt screw and wire pressed not turned into the plaster filling. The wire is held firmly when the plaster hardens, but the screw can be turned out. This expedient is more useful in connection with cement walls and floors, in which case Portland cement is used instead of plaster for embedding the screw. Iron cements and plastic wood preparations are often used in the same general way. In no case should any weight or strain be put on the screws until the cement has become thoroughly hard.



Special plug for use in plaster, tile, cement, and stucco.

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If you or some one in your home have a troublesome ailment, a lamp like this will relieve it in a remarkably short time. It is a relief to the body and a relief to the mind.

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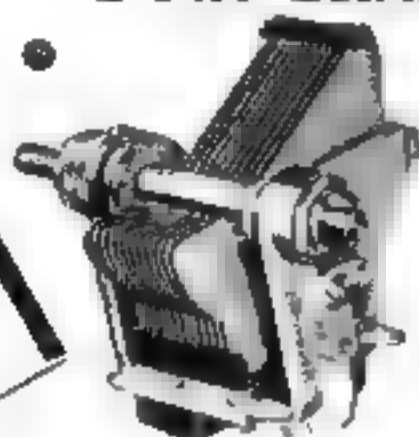
How to Waterproof Shoes

SHOES can be made waterproof or at least highly resistant to moisture by the use of one of the following formulas recommended by chemists of the U. S. Department of Agriculture.

Formula 1: Neutral wool grease, 8 oz.; dark petrolatum, 4 oz.; paraffin wax, 2 oz. Formula 2: Petrolatum, 16 oz.; beeswax, 2 oz. Formula 3: Petrolatum, 8 oz.; paraffin wax, 4 oz.; wool grease, 4 oz.; crude turpentine gum (gum thus), 2 oz. Formula 4: Tallow, 12 oz.; cod oil, 4 oz.

Which formula to use depends upon the ease with which the materials can be obtained. These ingredients must be melted before being mixed and applied warm, but not hot, to all outside parts of the shoes or boots. The soles are then saturated by setting the shoes or boots in a shallow pan with sufficient melted grease to cover the soles. Rubber heels, however, must be kept out of the mixture.

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A definite program for getting ahead financially will be found on page four of this issue.

Liquefied Helium Boils on Ice and "Freezes" Tin

(Continued from page 120)

contained nearly two per cent of helium. A 15,000 cubic-foot-a-day plant went up, drills found still richer helium at greater depths, and at the end of 1917 the plant was running. A plant was also opened in Canada, where helium had also been discovered in smaller quantities, but was shut down when the war ended.

When news came that the Petrolia gas field of Texas, which included the Fort Worth plant and two others, was nearing exhaustion, a hasty search for new fields was made. The result of this is the new plant at Amarillo, Texas, which embodies in its machinery the latest methods of helium extraction developed by the Bureau of Mines.

To extract helium from natural gas, the gas is piped from the well into mighty compressors where it is squeezed and then chilled to a temperature of 300 degrees below zero. At this searing cold, everything but the helium turns to liquid. The helium is then drawn off, still a gas, and squeezed again into cylinders or tank cars for transportation to the air field, while the natural gas, actually improved in quality by the helium extraction, is sold for light and fuel as a by-product. Formerly the chilling process had to be performed in several stages, at great expense but the Bureau of Mines has so perfected the system that the whole process is now a single operation.

One of the few remaining difficulties was the transportation of the gas. Formerly it was shipped only in cylinders, of which it took 15,000 to fill the ill-fated *Sherwood* at her first inflation. With the co-operation of a great steel concern, a special tank car was devised that consists of three steel tanks forty feet long and nearly five feet in diameter, mounted on a flat base. They contain helium forced in under the crushing pressure of 2,000 pounds to the square inch. Twelve of these railroads will fill the *Los Angeles*.

A final problem was the purification of helium from an airship's gasbag, contaminated by air filtering through the envelope after a long flight. Three purifying plants have been built by the Bureau of Mines, one of them a mobile plant in a railroad car. A stationary plant, at Scott Field, Ill., can reclaim 10,000 cubic feet of pure helium in an hour.

Huge Machine Makes Trick Shots for the Movies

IN THE latest moving picture technique, the camera is used much in the same manner as the human eye, seemingly wandering up and down and to the left and right at will. This new technique is responsible for the life-like quality of such scenes as, for example, a performance of a trapeze artist in the top of a circus tent, followed by a closeup of a section of the staring, breathless audience below.

How are such sequences made? P. W. Murnau, the German motion picture director, now in this country, in collaboration with experts of a steel company, has perfected the device that makes the "trick-shots" possible. It is a twenty-ton piece of machinery, resembling a derrick, with an upright mast in the form of a telescopic piston which can be shortened or lengthened. A horizontal boom also can be increased or decreased at will. To this boom either a platform or cage is fastened, and it is upon the platform or in the cage that the camera men work. The cage is used when downward "shots" are made. If the platform is employed, the photographers and their equipment are strapped in place, to prevent them being hurled into space by the swift motion of the boom in describing its arcs.

The telescopic mast of the device is operated by hydraulic power, while the boom is worked electrically.

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TAPERING the charging rate automatically. The new Elkon Chargers have added another feature to their many advantages:—

Dry—no acids, no water, no corrosion, no bulbs, no tubes, no noise, no moving parts, high charging rate when the battery is low, low charging rate when the battery is high.

The Tapering Charger, 1 Ampere, maximum charging rate is the ideal power supply for the storage battery. Leave it on all the time, without interfering with reception and without injuring the battery. Long life. Instructions and Guarantee printed on container.

The 3 Ampere Tapering Charger is ideal for the rapid charging of either radio or automobile batteries. Has all the advantages of a smaller charger.

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ELKON Replacement Rectifiers

This exclusive feature of the Elkon Rectifiers is saving customers millions of dollars! After a long time—5000 hours for battery chargers—a year or so for "A" Eliminators, renewing the rectifier will prove to be an economy. The old rectifier may be shipped out and the new one put in—only a minute required—and the unit is as good as new.

If you have a power unit using a dry rectifier, ask your dealer about the Elkon Replacement Units. Remember Elkon is the only unit authorized by Fansteel to replace the acid jars in the Balke power units.

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2-29

Men and Ideas Setting the Pace in Aviation

(Continued from page 41)

craft could escape the novel gun's peppering.

Its mechanism moves the gun barrel to weave a regular pattern of fire, automatically in a way that gives it the covering power of a shotgun instead of a rifle. An adjustment adapts it for long or short range. Tests of the device are planned by the Army Air Corps at Wright Field, Dayton, O.

Fights Fire in the Air

WHAT is said to be the only automatic fire extinguisher for planes has recently been introduced by an American plane-building firm. The device, a European invention, consists of a central chemical tank from which seven pipes terminate in nozzles at strategic points particularly subject to fire. Should a blaze start, the nozzles immediately could loose a high pressure spray to extinguish it.

"Prop" Blades Made Hollow

SOLID propeller blades may go out of style if six new experimental models recently ordered by the Navy prove successful. The new blades, of chrome vanadium steel, are hollow. They are said to be the first of this type that can withstand the strains of a high-speed airplane. Blades being light in weight, the old air screws are economical to build. A recently invented arc welding process joins two halves to make the finished propeller.

Hops from Train—Crash!

A CHICAGO pilot tried to take off, in his plane, from the roof of a speeding railroad train the other day. His plane was wrecked but the flyer escaped unhurt.

Eddie Ballough, the commercial pilot who made the try, was seeking to show the possibility of dispatching air mail from a moving train. His diminutive Monosoupe machine was secured to the top of an Illinois Central train outbound from Chicago. When the train was making sixty miles an hour a cross current lifted one wing and the plane went out of control and crashed upon the northbound tracks. Ballough crawled out of the smashed cockpit with only a scratched knee to show for the mishap.

"Aerial Fish Express"

AN INTERNATIONAL "aerial fish express" is soon to be established between Mexico and the United States, according to a Mexican government official. Refrigerator airplanes are to rush cargoes of perishable sea food between Laguna Madre, Mexico, and Houston, Texas. The novel project is backed by Houston business men, who have purchased planes for the service.

Duration Record Stands

RECOGNITION by the U. S. branch of the R. A. F., world aero governing body, makes official the new American duration record of fifty-nine hours in the air, set not long ago by the round-the-world aviators William Brock and Edward Schlotz. The world's record is held by Germans.

Even Ice Cream by Air Mail

TWO quarts of ice cream recently traveled from Utica, N. Y., to Texas via air mail. to be eaten there next day. With the container, the bundle weighed twelve pounds and bore \$18.50 in air mail stamps.

Hundred-mile-an-hour mail delivery has sped other odd items on their way; everything from bread to pawn tickets and jewelry.

Milder than what?



WELL, milder than what you've been smoking. Milder, and mellow, and for two perfectly good reasons: it's choice leaf and it's aged more carefully in the warehouse. Result, Sir Walter's favorite smoking mixture has so much genuine distinction of flavor and fragrance that sophisticated pipe smokers are prompt to recognize it and enthusiastic.

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SIR WALTER RALEIGH

Who discovered how good a pipe can be

It's



milder

Prospecting for Gold with Electricity

(Continued from page 10)

a radio direction-finder to trace the underground currents' path by their magnetic effect in the air.

The leapfrog method consisted of laying wires on the ground side by side, taking electric measurements, and then lifting or "leap-frogging" one wire over the others and repeating the readings.

In another experiment the prospectors found that they could use the current of three ordinary radio "B" batteries, hatched together, in place of the telegraph transmitter. Dial-reading electric instruments, instead of headphones, then measured the currents' path.

Magnetism, radio, and seismic shocks are some of the other fascinating new treasure-finding aids lumped together under the title of "geophysical prospecting."

A few ores, notably the magnetite, are magnetic. Like the lodestone of ancient mariners, which was simply a piece of magnetized iron ore, they deflect a compass needle near by, and play tricks with a more distant, but more sensitive, electromagnetic detector, such as a modern "magnetometer."

WHILE the Bureau of Mines experts were using electric instruments to survey the Caribou Mountain magnetite deposit, two experts of the Colorado School of Mines, Dr. C. A. Heiland and J. A. Malkovsky, surveyed it with a magnetometer, by taking advantage of its magnetic properties. A highly accurate map resulted that checked closely with the electric survey and the original Geologic Survey map.

Amazing mineral "finds" of gold and other precious substances have been reported by the use of radio waves. Radio waves, directed into the earth and striking an ore body, are said to cause the buried metal to rebroadcast a new radio wave, through which its location may be detected—much as a local radio station rebroadcasts, on a different wave, a program received faintly from a distant station. Multiple ores such as those of iron, copper, silver, and silver are described as peculiarly susceptible to discovery by radio apparatus.

Experiments by the Bureau of Mines in a Caribou Mine shaft to find whether radio waves would penetrate rock to any great distance showed that with a super-heterodyne radio receiver signals from above the earth could be detected at least 500 feet underground.

So successful has prospecting for oil with artificial earthquakes proved that several great oil companies are using it extensively, particularly in the San Joaquin valley in California. By measuring the speed with which earthquake waves from dynamite blasts travel through the earth, observers can tell whether underground domes of salt, which are often associated with oil pools, occur in the vicinity. The depth of a layer of possible oil-producing shale is also indicated.

Seismographs or earthquake detectors are used. These record the tremors on photographic film. In one recent method, which substitutes blasting gelatin for dynamite, a row of charges is shot off and the time of the shock's arrival indicates the depth of the underlying shale. Loudly radio flashes time the earthquake wave's speed.

But this is not all. Actually weighing a portion of the earth's crust, to detect oil or ore veins beneath, is possible with an extremely sensitive weighing device known as the baton balance. Because oil is lighter, and metal heavier, than the earth, the difference registers on the delicate instrument. Of course it cannot weigh directly, but resembles instead the device recently used by Dr. Paul Heyl, of the U. S. Bureau of Standards, to weigh the entire earth. Used for prospecting, it indicates the density of a portion of the earth crust.

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Remains true to his
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twenty-three years

IF any man be a sound judge of what's right and what's wrong, it's Justice of the Peace Hostock. And no exceptions taken on pipe-tobacco or any other decisions that may be handed down in the county court-house.

For twenty-three years this gentleman has rendered opinions favoring just one brand of tobacco—Edgeworth. He says he's smoked more than eight thousand tins of it! Which certainly places him high among the long-time smokers in the Edgeworth Club.

Spawick, N. Y.
Sept. 4th, 1936

Larus & Bro., Co.,
Richmond, Va.
Gentlemen:

In answer to the challenge of J. J. Rohrer a 2nd Columbia N. Y. as printed in the Minneapolis Journal dated Sunday, September 2, I have smoked Edgeworth for twenty-three (23) years, and for two years previous to that time I smoked Ghoul which, I believe, is manufactured by your firm.

During this time I have smoked at least one tin each day, and to verify this statement you may address the J. J. Rohrer of this city where I make my tobacco purchases.

It may be interesting to know that my purchases of tobacco with the big tin of all have totaled more than 8,000 right through these 23 years and now, representing a total amount of more than \$12.50 were hundreds of tin size cigars.

I have never smoked any other brand of tobacco but Edgeworth during the twenty-three years.

Yours very truly,
(signed) Chas. Hostock
Justice of the Peace

Any man who stays with one brand of pipe tobacco for twenty-three years must have a pretty good reason—and in the case of Edgeworth it doubtless is because Edgeworth never varies.



Personal: To those who have never tried Edgeworth, we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe-test.

Simply write your name and address to Larus & Brother Company, 10 S. 21st Street, Richmond, Va. If you like these trial samples you'll find tins of Edgeworth of the same like-

able quality on sale at all tobacco stores. Edgeworth Ready Rubbed comes ready for your pipe. Edgeworth Plug Slice is for pipe-smokers who like to "rub-up" a pipeful in the palm. Both packed in pocket-size packages, in pound humidifier tins and also in several handy in-between sizes.

On your radio—tune in on WVA, Richmond, Va., the Edgeworth Station, Wave Length 270 meters, Frequency 1110 Kilocycles. Special Feature: The "Edgeworth Club" Hour every Wednesday evening at nine o'clock, Eastern Standard Time.

Marvels of Plane Design

(Continued from page 49)

body, it has almost all been absorbed into enormously thick wings. All these ideas may help, and perhaps it is just as well that airplane designs continue to be as diversified as they are today until all the promising designs have been tried.

Another way to improve the load-carrying ability of planes is to increase their power by cutting out air resistance. Landing gears, for instance, are very necessary for taking off and landing but are a nuisance in the air. Some idea of the terrific toll they take in power may be imagined from the fact that simply covering two spoked wheels, 28 by 4, with cloth cuts their twenty-eight-pound air resistance in half. And the fourteen pounds saved would enable a plane to carry 120 pounds more fuel with the same power expenditure. But suppose the whole gear, wheels, struts and all, could be tucked away in the machine's body as a bird tucks its legs in flight? It sounds simple, and undoubtedly will be done in time. But mighty few designers have succeeded in producing an easily strong structure that will unfold infallibly when it should. Rather than chance wrecking a machine, they have turned instead to bringing their craft out of the early "bird cage era" by eliminating stray wires.

MORE efficient wing sections—a wing section is what one would see if the wing were sawed through in the direction of flight—help cut down power consumption. Lately Dr. Max Munk, of the National Advisory Committee's staff, has worked out astonishingly successful wing sections which, his associates believe, go a long way toward solution of the problem.

But though the finished airplane may be the last word in efficiency as to power and lift it is useless unless its controls are infallible. Through some use of a blunder, one of the new British fighting machines developed during the war could not make a right turn except by skidding—like skidding in a motor car. A British war pilot has recorded how a squadron of these machines met a German squadron and executed a skidded right turn. The Germans thought they were being "budded," whereupon the whole Maltese-crossed squadron promptly looped the loop. After the disastrous fight that ensued, pilots of the surviving British craft speedily put their skidding machines out of commission in numerous accidents that may not have happened solely by chance. Fortunately new airplane designs appeared on the front about every eleven weeks.

EVEN in standard aircraft models, pilots occasionally report "dead spots" in the controls, which, in certain positions of the plane, have no effect at all. Recent studies have shown ways to combat the defect, but probably the pilot will always have to be constantly alert. When a machine stands on one wing tip, for instance, rudder and elevator take over each other's duties. Reactions to such changes must be practically instinctive.

Most persons imagine that a low speed—meaning about thirty miles an hour—is desirable for landing. True, a pilot grounding his plane at sixty miles an hour, the landing speed of some fast machines, has only one second in which to recognize obstructions eighty-eight feet ahead. But it is obvious, even to a novice, that a machine traveling fast when it lands is likely to be a shorter time within a particular zone of turbulent air than a slow-moving craft.

At low speeds control of a plane is very small, for all practical purposes. But at high speed a plane control "grips" the air, a fact that can be verified simply by swinging about a piece of cardboard in the hand.

Comfort in the air is another good reason for fast landing and flying. (Continued on page 140)

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AMPERITE
The "SELF-ADJUSTING" Rheostat

Marvels of Plane Design

(Continued from page 124)

craft. A machine that lands at low speed is slow in the air. Bumps in the air become intensified with slow cruising. A plane with a top speed of fifty miles an hour would shake its passengers black and blue on a bumpy day.

Our machines today are standardized to the extent that they have usually one body, a big wing or two in front, and a little one behind. No one knows what would happen if the rear wing were made as big as the front one. There is some experimental evidence on the subject which is not conclusive, and power-driven machines of this type have so far proved unfortunate. Another novel departure, the vertical flying "helicopter" of popular dreams, likewise awaits further development. One English inventor has spent more than \$250,000 in experiments with the helicopter, while an American inventor has likewise invested great sums. Their success, though measurable, has been small.

AIRPLANE experimentation is one of the costliest things on earth, and it is this cost that keeps designers cautiously following in each other's footsteps. Formerly a new production, still in its experimental stage, would be taken from the factory and turned over to a test pilot. If the man liked the machine it would be put into production. This threw the whole decision upon the test pilot, and, being human, he was likely to make a mistake.

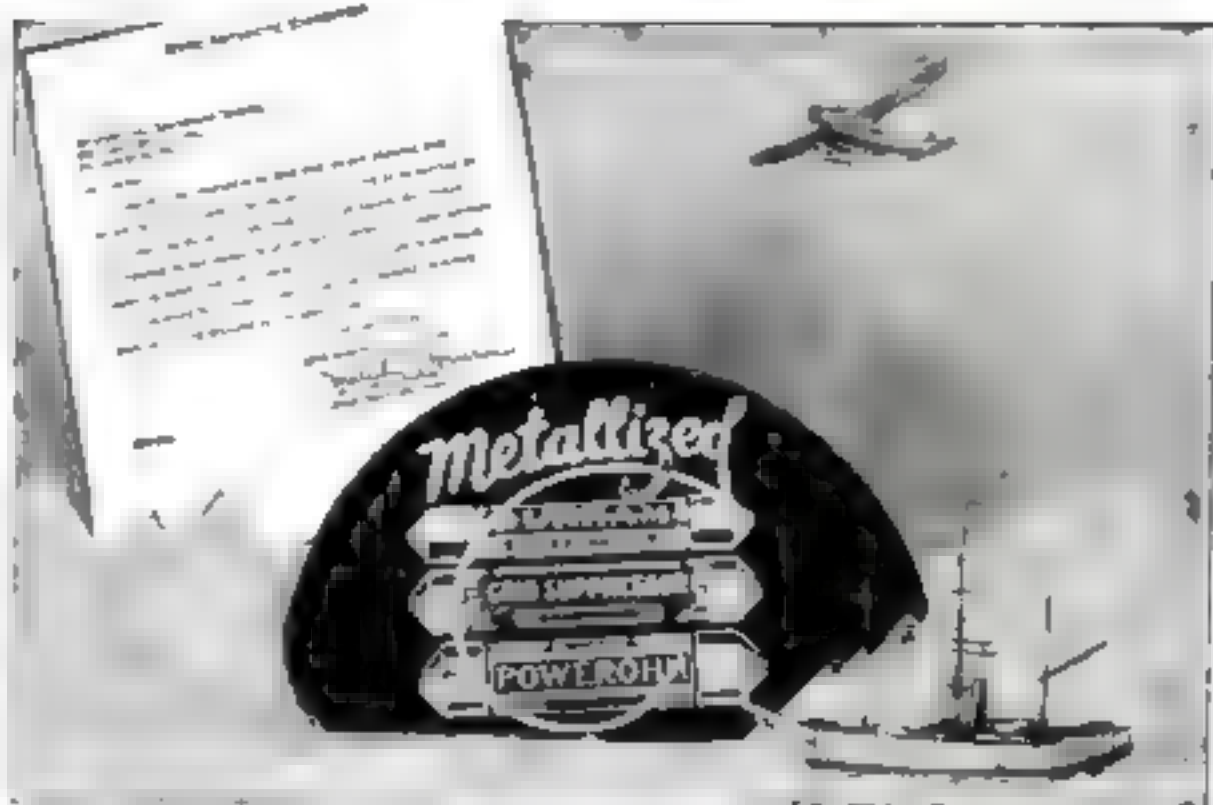
So far the most successful way of testing a new design is to construct a small model, fit it in a "wind tunnel" on suitable scales, and turn a high wind against it. Because the models are very small they must be accurately made if the result is to be reliable. This accuracy means costly hand work. If a complete wind tunnel test is run on a new design, the cost is likely to be about \$1000. But by combining a wind tunnel test on a model, and tests with strain-recording instruments on the finished plane, a very complete check on the design is possible. Even so, designing a plane will remain an art, rather than a science, until the whole thing can be done mathematically.

No airplane could leave the ground, no matter how perfect its design, without a motor that is a masterpiece of engineering for its combined lightness, economy of fuel, and power. While an automobile used in city driving may burn up from a pound and a half to two pounds of gasoline each hour for every horsepower that it develops, a modern airplane engine will perform consistently on about half a pound per horsepower hour. Even a plane with a 200-horsepower motor, despite popular opinion, is economical to run; a modern machine so powered makes eight to ten miles on a gallon of gasoline.

WHO would think, after seeing the heavy cast iron of automobile engines, that a cylinder wall barely $\frac{1}{16}$ of an inch thick is strong enough for an airplane motor that must bear far higher strains? Yet hundreds of airplane pistons dance tirelessly on their limited path, separated from the outside air only by such a narrow margin of metal.

During the war an engine that would run more than seventy hours between overhauls was considered a good one. Now there are motors that run as long as 400 hours before a general overhaul is required. No more striking excerpt from the fascinating story of the airplane engine's development could be found than the evolution of the air-cooled motor.

Only a few years ago it was thought impossible to design a really satisfactory air-cooled motor of more than 100 horsepower. Then came a period of study and testing. Heads were screwed on, bolted on, and shrunk on. Valves made of uncommon alloys were tried. One material after another was made into cylinders and tested to (Continued on page 130)



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RAYTHEON MFG. CO.
CAMBRIDGE, MASS.

Washington and Lincoln Both Were Inventors

(Continued from page 135)

of the boat was over the dam and was so pointed down that the water got in and sank the craft lower and lower. Things looked bad. A load of pork barrels began to slip toward the sinking end.

People from the town came out to enjoy the excitement. But to Lincoln it was no holiday. All day he worked there, trying to scheme out a method to save the boat. At last he hired another boat, brought it up as close as he could, and unloaded the pork barrels into it. Then, getting an anger, he bored a hole in the bottom of his own boat and invited the people to come on and help weight down the other end. The water began to drain out, and the boat was saved.

"That young feller, he's got ideas," the crowd said.

Safely over the dam, Lincoln plugged up the hole and got the boat to New Orleans. But the experience made a deep impression.

TIME passed, and the former river boatman went into politics and was elected to Congress. Once, returning home from Washington by way of Niagara Falls, he was proceeding on by boat through Lake Erie. And what should happen but the very thing which had happened when he was a boatman on the way to New Orleans. The boat stuck.

The captain had faced that problem before. He piped all hands out and ordered them to take all the barrels which could be found aboard and to force them under the side of the ship below the water line. Imagine the shouting and hullabaloo that went on as this was done by the rough deck hands of the day! And then, slowly but surely, the boat began to rise. And as it rose Lincoln stood at the rail watching intently. This was his own language, something he knew about. Seventeen years ago he had wrestled with the same difficulty.

Taking a piece of paper from his pocket, Lincoln sat down, placed it on top of his high hat, and began to make some sketches.

"I think maybe I've got an idea," he said.

When he returned to Springfield he went to see a merchant who had a shop near Lincoln's law office. The man loaned Lincoln his tools and Lincoln began to work out his invention in the man's shop. The idea of it was that, by means of a bellows, air could be forced under the ship to lift it free from its difficulty.

HE USED the tools, but much of the device he whittled out by himself. Contrast the different methods employed by Washington and Lincoln. When Washington had an idea for an invention he could have his own smith do the work for him. Lincoln had to do his own.

Lincoln began to whittle at the model, but also he had to keep his law office going, and so he took it to his office and sometimes would do some of the whittling between clients. At last the model was finished. It was about twenty inches long. He gave it a rather long and unimpressive name—"An Improved Method for Lifting Vessels Over Shoals." He sent it to Washington and applied for a patent. It was granted by the issuance of Number 6,469, and Lincoln was really and actually an inventor. The model he built can be seen today in the Patent Office in Washington.

But Washington was a more practical man in this respect than Lincoln was, for Washington's inventions were used, while Lincoln's wasn't.

Like Washington, Lincoln had an interest in mechanics, but his interest was that of a lawyer. Once he delivered a lecture which he called the "Age of Different Inventions." He liked to talk and philosophize about inventions, while Washington was interested in getting out and making an invention work.



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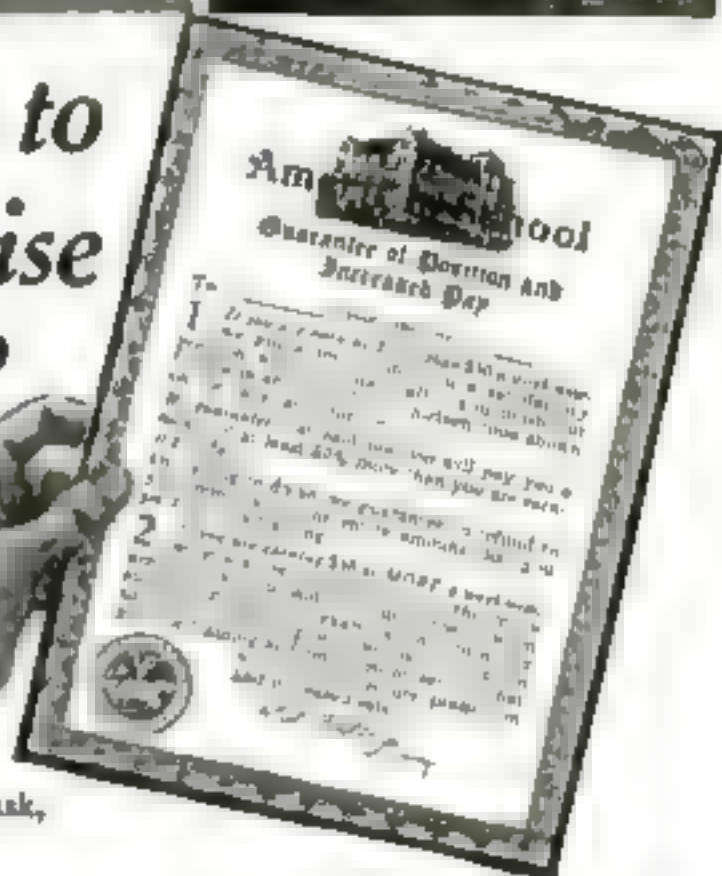
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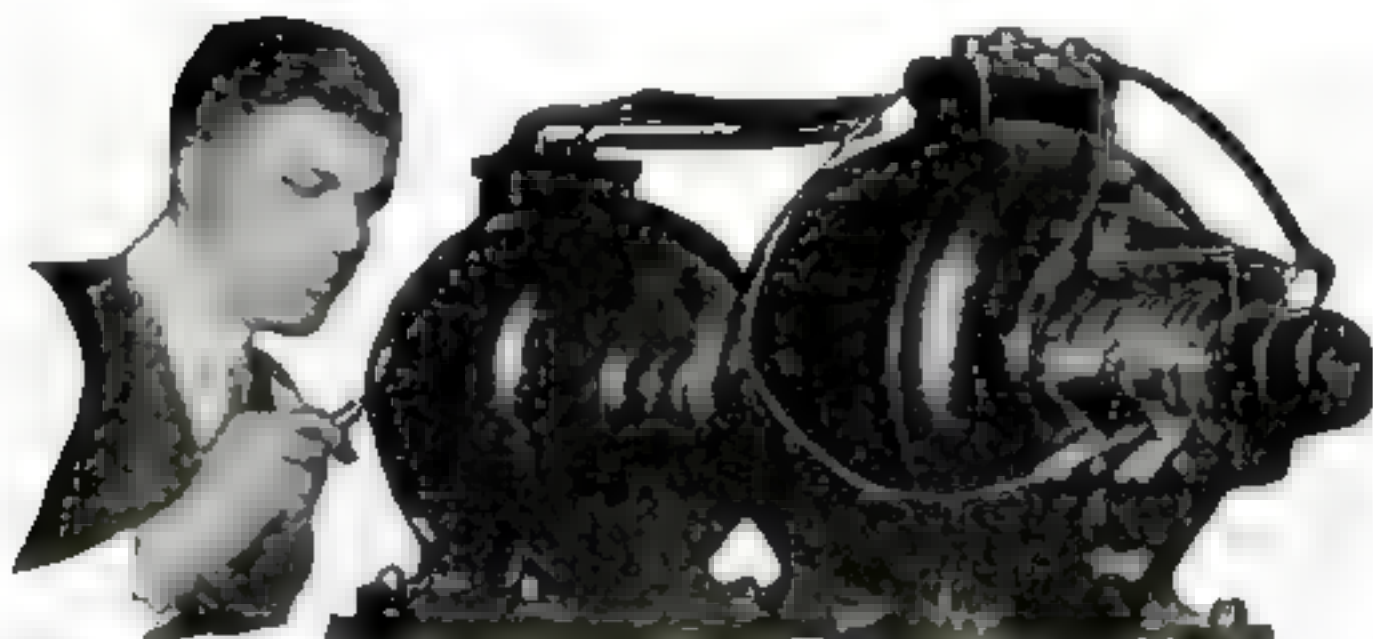
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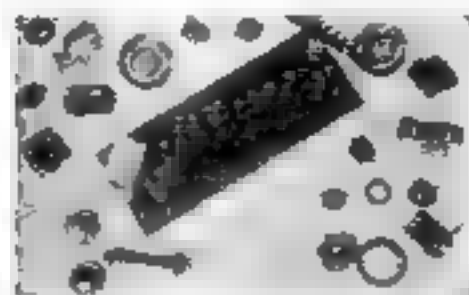
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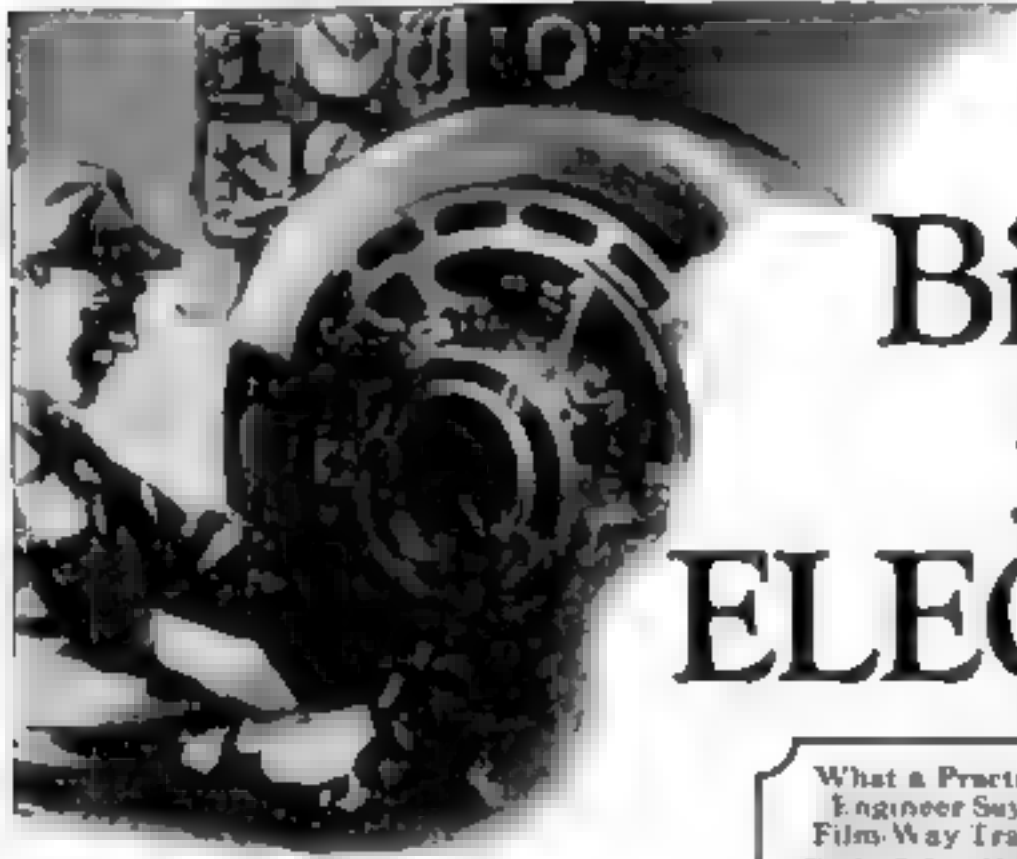
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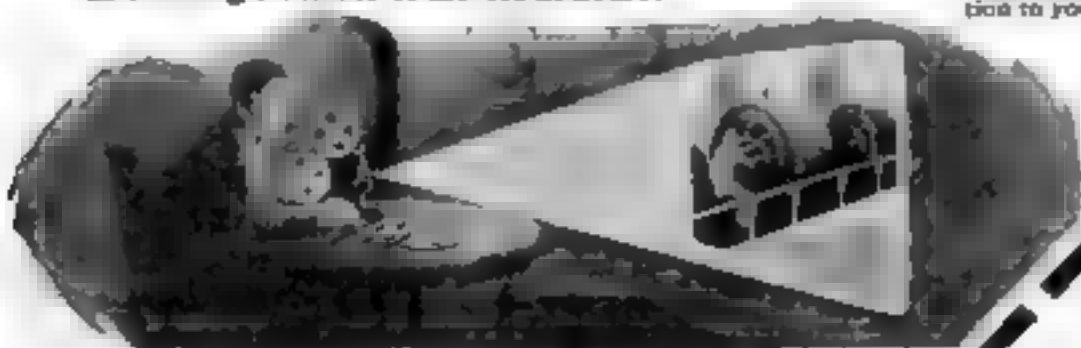
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TAKE THE FILM WAY TO Bigger Pay

Animals Really Think

(Continued from page 146)

a canine counterpart of Houdini. In the course of the story, Flash was locked in a sack and bound with ropes. When the director proceeded to show him how to loosen his bonds there were angry growls from Flash. In a minute or two, the dog freed himself with his teeth and sundry wriggings of the body, while the camera man calmly shot the exciting scene. Another motion picture animal that repeatedly has given indications of intelligence is Rex, the wonder horse.

REX'S and Black Bear's uncanny powers recall the marvelous accomplishments of Clever Hans, the horse trained by Wilhelm von Oaten in Germany, which, from 1896 to 1910, aroused the scientific world. Hans possessed all of Black Bear's ability, but, in addition, could recognize people from a previous glance at their photographs. The animal caused much controversy among the German professors. Numerous tests were conducted, and it was finally concluded that Hans was a "fake" and his performances a "mind-reading" stunt. All this happened before psychology—not to mention animal psychology—was taken as seriously as it is today. Somehow it never occurred to the professors that a "mind-reading stunt" presupposes the possession of a mind with which to read other minds!

They were, however, probably right in one particular—namely, that the mental accomplishments of animals trained by man, or in such constant contact with him that imitation becomes a fairly easy matter, do not offer the most convincing proof of native intelligence. To ascertain whether animals think of their own accord, one must either study them in their native haunts or in a zoological garden.

At the top of the intellectual ladder, so far as wild animals are concerned, stand, of course, the anthropoid or manlike apes. Of these, the chimpanzee is the most intelligent. The orang-utan is rated next in mental equipment. Third on the list comes the Indian elephant. In the specialized department of domestic economy, the beaver—the architect and engineer of the animal kingdom—manifests more intelligence, mechanical skill, and reasoning power than any other wild animal. And in the matter of self-preservation, zoologists reluctantly hand the palm for the greatest cunning and foresight to the common brown rat!

AS for the apes, almost every one has seen well-trained chimpanzees do their amusing imitative stunts on the stage and in the movies. But it was left for the officials of the New York Zoological Park to discover that the orang-utan possesses native inventive genius!

Some years ago Dohong, an orang-utan, developed a faculty for mechanics and invented the lever as a mechanical force as fairly, squarely, and independently as Archimedes discovered the principle of the screw!

It was a great day for Dohong when he found he could break the wooden one-and-a-half-inch horizontal bars that were held out from his cage walls on cast-iron brackets. Before his keepers could stop him, he had gleefully destroyed two and was attacking the third—with a broken piece used as a lever!

Promptly the bars were replaced by larger ones, of harder wood, but screwed to the same cast-iron brackets. For a while, Dohong was stumped. But soon the wise old ape conceived the notion of swinging his two-inch oak trapeze bar far over to one side of his cage and of applying the bar as a lever, inside the horizontal bar, from above. Naturally, the brackets gave way. They were replaced with heavy brackets of flat wrought-iron bars, one half by two and a half inches, fastened with heavy screws. (Continued on page 148)

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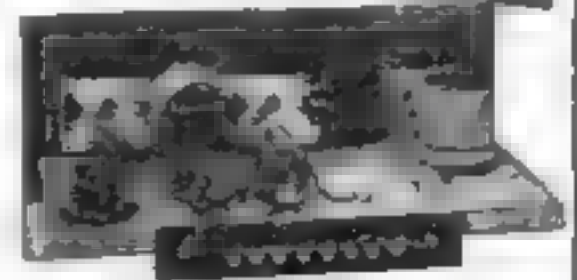
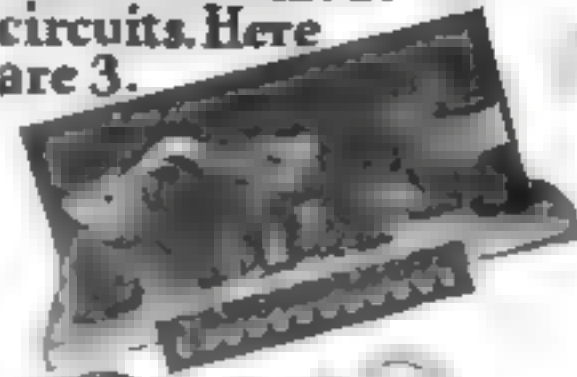
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Tides Make the Earth Boil Over

(Continued from page 45)

Because practically every active volcano in the world is located not far from large bodies of water, the theory is advanced by Dr. William Bowie, of the U. S. Coast and Geodetic Survey, and others, that the kneading action of the periodic tides twists the earth, forcing up the lava and causing volcanic activity.

Concerning the source of the heat that forms molten rock, or magma, one theory is that increasing internal pressure causes it. A second is that the heat is produced by chemical action. Another is that the friction of shifting layers of rock generates it. Major C. E. Dutton, a geologist of the U. S. Geological Survey, has advanced the idea that the real secret is radium! Radioactivity in the rocks, he says, is sufficient to melt them in certain places, forming large subterranean pools of lava. Added weight is given to his suggestion by the report of Dr. John Joly, British geologist, that radium is present in all igneous rocks.

ONCE lava leaves the crater of a volcano, its course down a mountainside seems governed by caprice. In the recent Mt. Etna eruption, a beautiful grove of lemon trees lay in the path of the crimson avalanche. But, just before it reached the trees, the fiery stream seemed to pause. It turned aside and attacked a heavy stone wall, which it crushed as though it were pasteboard.

At another place a gambler, taking a long chance on his luck, offered a trifling sum for a villa that seemed doomed by the approaching lava. No sooner was the bargain struck than the stream divided into two parts, cutting off a corner of the garden but availing the house.

Why do people persist in erecting homes on the slopes of these menacing mountains? Dr. H. B. Washington, noted volcanologist of the Carnegie Institution, explains that nowhere in the world is there such fertile vineyard ground as that produced by weathered lava. The famous grape areas of northern France and southern Germany, as well as those around Mt. Etna in Sicily, are rich in this material.

To safeguard homes near volcanoes, many attempts have been made to govern the flow of lava. A sugar mill owner in Hawaii is reported to have saved his buildings by pouring water on the advancing front of a lava stream. The water "froze" and hardened the lava until a dike had been formed to turn the main stream aside down a gully. A few years ago, scientists shot chemicals into the crater of a volcano in South America in experiments to control its activity, but without success.

UNTOLD fortunes in gases and chemicals valuable to industry are wasted in the atmosphere every time a volcano lets go. "The Valley of Ten Thousand Smokes," in Alaska, a volcanic field formed by the eruption of Mount Katmai in 1912, has been called a gigantic chemical laboratory. Here thousands of fuming holes in the earth vomit steam and gases, the volume of which has been estimated at 8,000,000 gallons a second! The chemicals thus thrown away each second, according to Dr. E. G. Zies, of the Geophysical Laboratory, include sixty-four pounds of hydrochloric acid, twenty-two pounds of hydrogen sulphide, which has many important uses in industry, and nine and a half pounds of hydrofluoric acid, used for etching glass. It has been estimated that these chemicals, if they could be captured and put to use, would be worth \$17,000,000 a year—more than twice the price paid by the United States for Alaska.

Many mysteries beneath the earth's crust remain to be penetrated, however, before men can hope to harness the destructive mountains. Science today is surer of what goes on millions of miles out in starry space than it is of what takes place beneath our feet.



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The Real Fathers of Flight

(Continued from page 14)

craftsmanship that enabled them to build the airplane. Their first experiment in wind pressure was made with a whirling top on a bicycle which they pedaled through the streets of Dayton. Their historic first flight of 1903 at Kitty Hawk, N. C., would have been a fiasco without the saving virtue of a small portion of bicycle cement!

Wilbur was twenty-five and Orville twenty-one when the brothers opened their bicycle repair shop.

If you want your bicycle fixed right, take it to the Wright brothers, was the word shortly passed around Dayton. "They are reliable, and fair in their charges."

THE business grew into the sale of new wheels and trading in old ones. In four years the prospering owners had their own model to offer the public, the Van Clave bicycle, named after an ancestor who helped to found Dayton. The machine was assembled by the brothers from purchased parts, yet it was first class and up-to-date. About a dozen of these wheels were sold the first year at a price around \$100. The assembling shop on William Street had good equipment that included an emulating oven.

Orville had typhoid fever in 1896. He was looked after jointly by Wilbur, a trained nurse, and Katharine, home on summer vacation from Oberlin College. I can see Wilbur waving a palm leaf over the fevered patient, keeping it up with monotonous regularity, changing hands to rest muscles, perhaps speculating on a device for an automatic power fan.

"Listen, Orv, we can imagine Wilbur saying one day to his just convalescent brother, 'you want to catch up on the news while you've been sick. Here is an item from Germany: Lenz has died!'"

"L. Lenz?"

"Yes, you know—the man who tried to fly with wings. Seems to me we both read about him in some paper or magazine along with the experiments of Marini and Langley."

"How did it happen?"

"Well, he made some short hops or glides as they call it. But the last time he fell somehow and got killed."

"Let's read up on the subject, Orv," Wilbur doubtless suggested. "I'll get what there is in the public library and you know father has a book on bird flight downstairs—'Animal Mechanism,' by a Frenchman, Professor Marey. We'll find out what there is in the whole business."

HALF an invalid through the autumn Orville heard his brother read aloud the thin and tenuous documents dealing with flight.

Flying then was on a par with spiritism. It had no scientific basis or repute. The literature was meager though inflated with words and cloudy guesses. The brothers, hungry for definite information, tried to find something to put their teeth into. They now took turns in reading aloud on winter evenings at home. After reading, they talked, argued, dreamed, and added cloudy guesses of their own to the fog-enveloped, illusory, and haunting topic. The brothers were just playing with a fascinating idea, amusing themselves. But the idea grew upon them. Perhaps at moments each had a secret vision of adding a tiny footnote to history. The footnote would be in small type. It was several years before they saw how that type might emerge and come to be the main text of the book of aviation.

The bicycle men of Dayton were now in the vigor of early manhood. While not robust, they were wily and athletic. They cooperated remarkably as

(Continued on page 152)

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The Real Fathers of Flight

(Continued from page 149)

physical as well as mental feats. For example, Wilbur was starter for Orville when the latter competed in amateur bicycle races under auspices of the local Y M C A. At the pistol crack, Wilbur shoved and Orville sped five lengths ahead of all rivals. The latter still cherishes his medals of victory in those races. I saw them in his Dayton home.

They found excitement in applying their wits to the solution of mysteries like that of the bicycle pedal, which had baffled the scientific experts of manufacturers. The pedals were unscrewing, riders complained, although they were designed to tighten in use. The keenly observant Wrights detected the source of trouble and told a thankful manufacturer that friction of the pedal shank against the crank shaft negated theory and unscrewed the pedal.

THEY sharpened their wits also on mental tests, so-called mind reading, and the tricks of spiritist mediums. They were keen scientific skeptics, putting a razor edge on their minds while training their bodies for a hazardous journey in the air. By force of circumstance they were compelled to build the flying machine of their dreams entirely in their minds. Whereas noted experimenters of the day could rely on costly test models and laboratory instruments, the two bicycle men had to think out every step and create a host of imaginary models which in turn they inspected, analyzed, critiqued, tore down, rebuilt, and finally threw away. They went back to the ancient method and relied first on their brains.

They staged home battles on imaginary aircraft. It was the agreed duty of each brother to attack, punch, and smash with all vigor the other's concept. Orville proposed, Wilbur knocked; Wilbur suggested, Orville swung a destructive blow. They often fought each other to a mental standstill but did not lose their tempers, for their object was a mutual quest of truth. After a fair fight the vanquished was quick to concede victory and to adopt his opponent's viewpoint.

"I like to scrap with Orr," Wilbur used to say, "because I like to scrap with a good scrapper."

Sometimes these idea-boxers chased each other around the ring so fast that at the going each had reversed his position and stood in the other's corner, which gave them a hearty laugh.

THEY obtained some new points to fight over in May, 1899, from pamphlets of the Smithsonian Institution, *The Aeronautical Annals of 1895-7, Experiments in Aerodynamics*, by Professor Langley, published in 1891, articles by Lilienthal, and parts of Mouillard's *Empire of the Air*. They had already read Chanute's *Progress in Flying Machines*. It was all a mess of conjectures, dreams, pseudo-science, and enthusiasm. But the last item—enthusiasm!—was truly valuable to the Wrights. It kept them going when facts and reason seemed to have nothing to offer.

The Maxim and Langley group of experimenters believed in power flight, while the school of Lilienthal, Mouillard, and Chanute practiced on gliding without a motor. The men of Dayton chose the gliding approach to the problem as more sensible and economical while, too, they were fascinated by the notion of flying like birds.

"Balance is the main problem," we can imagine the brothers agree after long debate. "And it isn't practical to keep balance in the Lilienthal and Chanute style with the rider shifting his weight six ways for Sunday. Half a minute in the air seems the limit for that moribund stunt."

(Continued on page 154)



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"how" can I get into Aviation?




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AVIATION is waiting for no one! Landing fields, plane and equipment factories, air lines, service and sales organizations—all are leaping ahead in the most amazing development program yet known. In each new age, somewhere there is a man who has it in his mind to do it. To our day, perhaps, the man is General H. H. Arnold. He is a man who has no time to sleep, eat, or drink. He is a man who is always off in the great unknown, fighting history, and the men who are going along and clanking to the top are the men with a foundation of PACTS under them.

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The Real Fathers of Flight

(Continued from page 744)

joint so that wires over pulleys might warp the wing structure. Wilbur shopped for the wires and wing covering. They did not assemble the glider in Duxbury, and planned to get some long sticks for the frame en route.

While Orville stayed to tend shop for a time, Wilbur started for Kitty Hawk around Sept. 1, 1900, taking the materials and a camping outfit. At Norfolk, Va., the pioneer found that spruce sticks were short, eighteen instead of twenty-two feet, so that the area of the glider would have to be reduced from 200 to 105 square feet. He had worse trials and tribulations ahead. At Elizabeth City, N. C., he engaged a tub of a sailboat to voyage down marshy Pasquotank River and across Albemarle Sound. Captain Israel Perry, who was also the crew, became hysterical when they ran into a storm with loss of anchor and other gear, so that the landlubber passenger had to take charge and save the ship.

IT TOOK a week to make the 600-mile trip from home to the fishing hamlet of Kitty Hawk—a point on a strip of sand thrown up by the Atlantic for many a league along the southern coast, separated from the mainland by shallow waters of Albemarle and Pamlico Sound. The strip is one half to three miles wide. Kitty Hawk is on the landward side at one of the wider parts, six miles from historic Hatteras Island and about sixty miles north of dreaded Cape Hatteras. While setting up camp, Wilbur stayed at the home of the local postmaster, William J. Tate. One day there was a bit of dialogue like this:

"May I use your sewing machine, Mrs. Tate?"

"Certainly, Mr. Wright, but can't I?"

"Thank you, Mrs. Tate. I can do it myself. Just want to stitch up a pair of wings."

The postmaster's little girls shyly watched and admired the cream-hoed satsum being stitched into wings by the rapaloe stranger. I suspect they dreamed in secret envy of a better use for that beautiful cloth. Anyhow next year the Wrights were pleased to see that the satsum, having served its first purpose, had been turned into gay dresses for the little girls.

ORVILLE joined his brother around September 23 and they hastened to finish assembly of the glider. Their wall tent, twelve by twenty feet, housed the machine, a small work bench, and themselves. They had a fair array of tools between saws, vise, and breast drill, and supplies of screws, bolts, locks, wire and strap iron, not to mention an item that they most regarded as a panacea for mechanical ills of every sort from slippage to fracture. I give the reader three guesses . . . yes, bicycle repair!

"Let's try it!" we can hear the impatient brothers ejaculate together when the glider was winged but yet balked the faint horizontal runner.

They hurried it out incomplete to a sand dune, tied a rope to its nose, and with a sevenish blessing let Eolus take the steel.

Hurrah! This was the reality of four years' dreams. It now pranced and danced, lugged with vigorous power against the arms of its enraptured creators. What a kite—no, what an air-burp for a man to mount and ride on! Now they had to ride, regardless of their set program to proceed slowly. They pulled Pegasus to earth and Wilbur stretched himself on it, face downward between wings. Orville gradually loosed the rein. It gambled upward with almost as much vigor and steadiness as before. The man on the ground exulted. It had been his boyhood passion to fly kites and now he was flying a super-kite with his brother aboard! Science?

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The Real Fathers of Flight

(Continued from page 155)

Pshaw, this was huge fun, the greatest sport of a lifetime.

Wilbur had another viewpoint and could not share the enthusiasm of the one below. He repented of his rashness in wanting to ride a critter so wobbly, sluggish, and dangerous. He was in the air. Earth seemed far below. In quick staccato he began to yell:

"Lemme down! Lemme down! Lemme down!"

The wind took his voice backward and doubtless Orville let out a bit more rope, thinking his brother was cheering and wished to go higher. Then he understood the purport of the summons and hauled Wilbur down from an altitude of something like eight feet.

ORVILLE was next to ride. He went much higher and had to jump all around that bucking bronco a back to save his neck while Wilbur ran lickety split downhill. The wild ride ended with a mild smash from which Orville rose unscathed. Repairs were soon made and the front elevating rudder was attached. The brothers took turns as jockeys, a halter rope still tied to the steel. Unlike their gliding predecessors who used a sitting position, they rode in a recumbent face-downward posture, feet hooked over a rear bar as body braces, hips in a tight but movable cradle, elbows in support with hands gripping a bar that moved the elevator rudder ahead. As the hip-cradle rocked sidewise its wire connections warped the flexible wing ends, raising one side while lowering the other, an alternate arrow action like twisting and untwisting a paste-board box.

The glider was tested with varying loads without passenger and put through its paces by cord control of its novel devices. When "lift and drift" were measured, the Wrights were surprised by results very contrary to accepted figures. There was half the head resistance of framing calculated by Chanute and the lifting power was much less than the wing curve should produce according to the Lilienthal table of air pressure. They thought perhaps they needed more curve and a cloth more air-tight than satin. Could Lilienthal and Chanute together be wrong? Well, they would build another machine next year and make the wings adjustable to various curves.

MEANWHILE they moved camp four miles south to Kill Devil Hill so as to have some real faunts on their air nag. The sand strip here is about a mile between ocean and sound. Kill Devil Hill, so-called through Indian legend, is the largest of several sand dunes wont to change their shapes by urge of Hatteras gales. It was then about 100 feet high and had a ten-degree slope northeastward. Seagulls, fish-hawks, buzzards, and eagles sailed over the sandy desert. Yet hoping practically to learn something from the birds, the Wrights staked them in action and carefully measured the wing spread of a fishhawk which they shot.

The second day after arrival at the hill the wind fell to a favorable speed of fourteen miles an hour and they made about a dozen brief glides. Postmaster Tate went along to help launch the machine. He and one of the brothers—the other riding—would hold opposite ends of the glider and run downhill with it against the wind. As the biplane went free its pilot shimmied his hips to keep sidewise balance and with his hands shifted the forward horizontal fin to maintain a fore-and-aft even keel. It was a pleasant discovery that the pilot did not have to make a two-point landing with his feet but could make a safe stop while recumbent at twenty miles an hour. Sand flew up under the skids on landing and it was needful to shut eyes. (Continued on page 158)

A WINNER!



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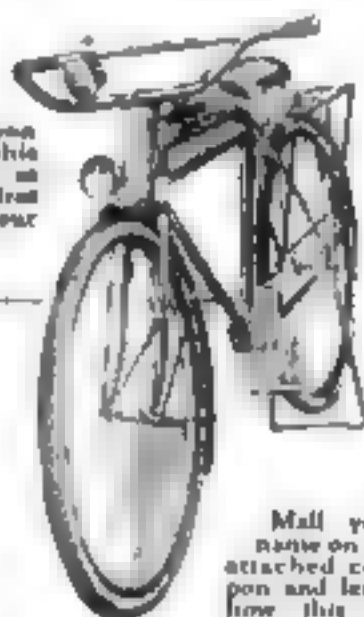
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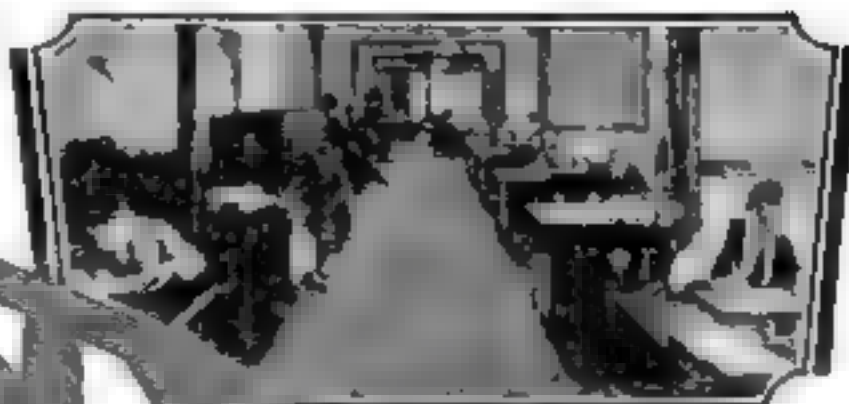
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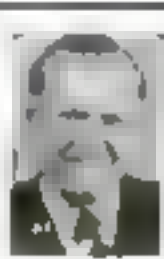


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Luxuries for the Home

(Continued from page 81)

walls and floor, as well as various fibers or mineral powders. One of the latter is applied with a spray gun to the walls.

That is the "skin" of the modern house. And within it lie the "nerves"—an intricate system of wires and conduits, piping electricity to every needed point, from cellar to attic, that makes the 1929 dwelling preeminently an electric home.

In living and dining rooms, abundant convenience outlets along the basement and in the floor avoid unsightly cords hanging from the wall whenever a bridge lamp or a toaster is to be plugged in. From the wall sockets, electric clocks give observatory time. A laboratory filled with labor-saving devices is the kitchen, where electric power runs the iron, the dishwasher sink, and even, in some of the newest homes, the kitchen range. In stairs, the bedroom closets are equipped with switches that flash on a light automatically when you open a closet door, and shut it off when the door is closed. Convenient switches near the bed floor a room with light at a finger's touch if the baby cries or if the telephone rings. A radio-tipped screw on the switch plate glows and helps you to find it in the dark.

MODERN three- and four-way switches enable you to turn on the lights in a room from one wall switch and turn them off from another—useful in a bedroom, for instance, where you light the lamps when you enter and turn them off from the bed. Then there is a wall switch with a red warning lamp that glows to remind you when you have forgotten to extinguish the lights in attic or cellar. A new two-watt lamp, supplied with a miniature transformer that screws into a socket, glows all night with a subdued light in the nursery, sick room, or bath.

How is the 1929 home heated? So seamlessly that the entire cellar may become an extra floor for recreation and living rooms. The latest thing in heating, we found, is the "gas conversion burner," an appliance that transforms your coal-fired boiler into one that burns gas. This new burner—which, by the way, looks so much like an oil burner that you might easily mistake one for the other—conserves the heat, directing it by refractory surfaces squarely against the side of the boiler.

There are new, improved oil burner models, too, for 1929. One well-known architect told us that he never plans a dwelling today without making provision for possible installation of an oil burner. Evidently shivering coal from a bin is going out of style, for now there is an "automatic furnace man," a device run by an electric motor, that stokes your heating plant with coal continuously without attention, it removes its own ashes and stows them in a container for easy removal.

ELECTRICITY, we learned, cannot yet compete with gas, oil, or coal for house heating as a whole. But now portable electric radiators plug into wall sockets to supply extra heat in a chilly room on very severe winter days, and in spring and fall when the furnace is not in operation. They are light enough to be carried anywhere.

This year may see a fascinating dream come true—the cooling of a whole dwelling, in mid-summer, just as some of our larger theaters and restaurants are artificially cooled at present. To date, we learned, no refrigerating plant has been devised that is inexpensive enough for the private home owner to install. But one manufacturer told us that he will place such a device on the market within a few months. It will operate, for private homes, in conjunction with a heating and air-washing plant that he already is manufacturing, and will cost about as much as the rest of the plant again.

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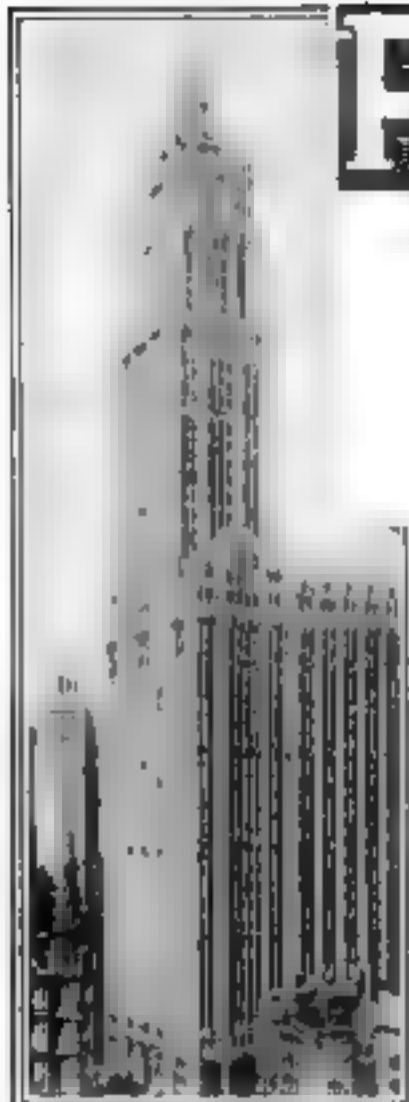
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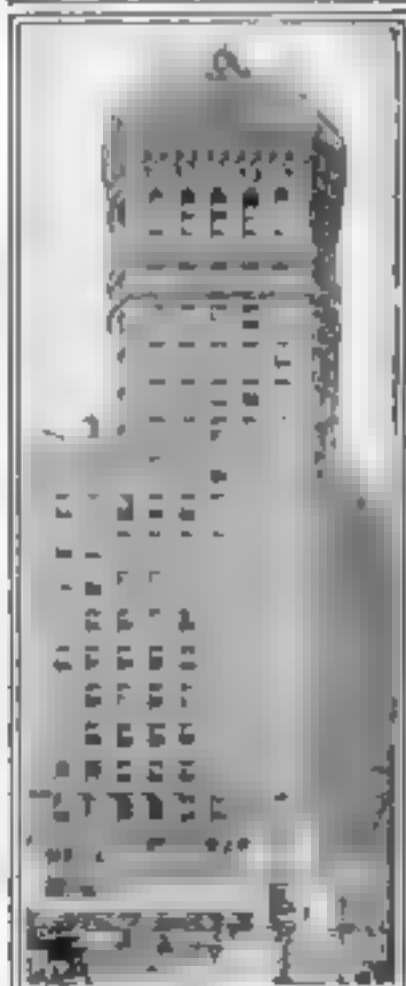
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If You Had Millions to Spend—

(Continued from page 162)

Aeronautics, and Harry Guggenheim became its president.

Now every working day finds Harry Guggenheim busy in his office, toiling to advance the time when a winged humanity will broaden the scope of its travels and its thinking so as to include the entire world. And that day, he firmly believes, will come within our lifetime.

"On what do you base that belief?" I asked him.

"On the extraordinary developments now taking place in aerodynamic design and in the construction and operation of aircraft," was his answer. "But to hasten the coming of universal flying mechanics, progress alone is not sufficient. The popular mind must keep pace with these advances; through constant education and demonstration of the safety and feasibility of flying as a mode of everyday transportation, the people of this country will have to acquire the attitude of faith, of confidence toward aviation."

"THE average man's attitude toward air travel today is still skeptical," he continued. "Of course, he is interested in reading of flying exploits and glad when his country's aviators set new records. But in the back of his head there lurks a deep-seated reluctance to trust that most elusive of the elements—the air. The fury of tornadoes ashore or typhoons at sea, for some reason, holds less terror for him than this paradoxical business of defying gravity with heavier-than-air machines. He may send his letters by air mail, but he prefers to let someone else do the flying!"

This, then, in brief, is the double purpose of the Guggenheim Fund, to help solve the remaining fundamental problems of aviation and to overcome popular skepticism of air transportation.

"What do you consider the fundamental flying problems that remain to be solved?" was my next question.

"There are four," he replied. "The production of an aerodynamically safe plane; the fighting of fog, one of the flyer's most merciless enemies; the development of a special aviation meteorology; and the overcoming of steel conditions."

Then he told me of the great international Safe-Aircraft Competition which the Fund is now conducting to help find the solution of the first and perhaps most important of these problems.

"BUT mind you," he said, "that is not the only reason for the competition. It is part of our educational program as well. Through this undertaking, we hope to achieve a real advance in the safety of flying by bringing out improvements in the aerodynamic characteristics of heavier-than-air craft without sacrificing the good practical qualities of existing design. But, at the same time, we expect to demonstrate that airplane travel is basically as safe as railway and steamship transportation."

The competition is probably the biggest single piece of work the Guggenheim Fund has attempted. As recognized an authority as Lindbergh said of it that "it ought to result in a ship comparable to the automobile for easy and safe operation."

Orville Wright is chairman of the international contest, which offers a first prize of \$100,000 and five prizes of \$10,000 each for the winning designs. So far, eleven entries have been made—five from this country, as many by British manufacturers, and one from Italy.

"What we aim to do," Harry Guggenheim explained, "is to encourage the development of safe aerodynamic qualities of aircraft. In accordance with the (Continued on page 164.)

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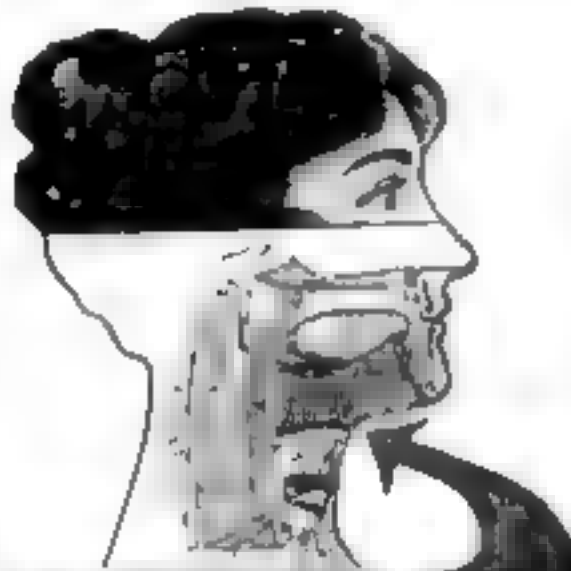
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If You Had Millions to Spend—

(Continued from page 163)

specifications developed for the competition, the following characteristics are sought: A plane that will land more slowly; roll only a short distance after landing; be able to make very flat glides; be able to glide steeply and in safety over obstacles surrounding the field; take off quickly and on a steep path; remain in perfect control after the stall and in all other flight attitudes and be inherently stable, when, owing to weather conditions, the pilot cannot himself maintain an even keel.

"The plane that meets this acid test will be a pretty safe ship. It will do a great deal toward making aviation not only a young man's game, but everybody's game, like motor-ing. Developments now taking place strongly indicate that planes will be produced in the near future that will satisfy the requirements of our competition.

THE contest will not close until October 31, 1937, and meanwhile the Fund is marshaling its forces in its war upon fog. Although Harry Guggenheim is not now prepared to predict that the problem will be solved completely, he is very hopeful that the gravest dangers attendant upon fog-flying may soon be overcome.

The flying laboratory just established in charge of Lieutenant James H. Doolittle, U. S. Army Air Corps, an experienced pilot of scientific and engineering training. Colonel Lindbergh, consultant of the Fund, was largely instrumental in organizing the project and acts as its special adviser.

Incidentally, when Lindbergh made his famous good-will tour of eighty-two cities which the Fund organized to dramatize the safety of flying, he landed on scheduled time, according to his custom, for every one of his stops but one, and in that case—at Portland, Me.—his lateness was due to fog.

Two biplanes, a Vought Corsair and a Consolidated NY-2, are used in the fog-fighting organization. Each plane is equipped with improved instruments designed to give the pilot his bearings in the thickest weather and to tell him his exact height above the ground at all times, thus completely robbing fog of its many perils.

The fog question naturally led to the next problem—the development of a special meteorology of aviation. Mr. Guggenheim told me that the Fund, not long ago, established a complete aeronautical weather reporting service on the Los Angeles-San Francisco runway. In this project, the organization received the cooperation of the Army, the Navy, the Department of Commerce, the Weather Bureau, and the telephone company.

IMAGINE a "main street" of the air with the aerial equivalents of stop, go, and caution signals, which each hour and a half, from 8:30 o'clock in the morning until 3:30 o'clock in the afternoon, receives reports from thirty-three stations in an area 400 miles long and 150 miles wide, and you have an idea of the extent and significance of this service.

The stations along the way furnish information on winds, clouds, fog, visibility, and weather, which are flashed by wire to airports and to such planes as are equipped with radio. The service is now used by several regular airlines and a great number of individual planes. Major E. H. Bowie, in charge of the San Francisco weather bureau, is the director. Dr. C. G. Rossby, of the Massachusetts Institute of Technology, consultant of the Fund, was prominent in organizing the work.

While on the subject of the elements, I asked Mr. Guggenheim whether he felt that transoceanic flights should be encouraged.

His answer was most emphatically in the negative. (Continued on page 164)

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If You Had Millions to Spend

(Continued from page 164)

"Spectacular transoceanic flights should most distinctly be discouraged," he said. "What we should encourage is the development of equipment that will make all flying safe! Under present conditions, we are over-training both our personnel and equipment in undertaking such feats. The splendid historic exploits of Lindbergh, Byrd, Chamberlin, Mailand and Hagenberger, Brock and Schlee, Goebel, and others were very important as a means of arousing the public imagination. But this purpose has now been served."

"And what of the future of the lighter-than-air ship?"

"At the moment the lighter-than-air craft seems to offer the only practicable means for transoceanic air travel, but our need, so far as heavier-than-air craft is concerned, is the development of seaworthy, multi-engined flying boats. America, which formerly led the world in flying boat building, is now far behind Germany and England in this regard."

"SPEAKING of transoceanic flying, I put in, 'a few women—and Miss Amelia Earhart particularly—have recently distinguished themselves in the air. Do you think there is a future for women in aviation, or will flying always be exclusively a man's game?"

"Not at all! You see, aviation, contrary to the general public impression, is not confined to the pilot; though he, of course, dramatizes and, in a sense, symbolizes flying to the man (and woman) in the street. But don't forget that a large ground personnel is highly essential. I, for one, see no reason why women should not enter this field, as well as other industries."

"And then, the airplane of the future will be just as easy to operate as the automobile of today and, therefore, in time to come, there will be in proportion as many women pilots as there are women drivers of automobiles at present."

"Then you think that all people are fit to fly?"

"By no means! On account of the great expertise required, the potentially great pilot is the exception rather than the rule. He must be physically fit, particularly alert, possess at most perfect coordination, be well-trained, and have long experience. But these requirements are bound to be eliminated in the future by the greater simplicity and safety of aircraft."

HUNDREDS of young men are deeply interested in aviation as a career, a fact attested to by numerous letters of inquiry received daily by **PORTER SERVICE MONTHLY**. For that reason, I next asked Harry Guggenheim to give his views on this subject.

He told me that, aside from its endorsement of the School of Aeronautics at New York University, the Fund has made grants totaling almost \$1,000,000 for laboratories, equipment, and experimental studies in the California Institute of Technology, the Massachusetts Institute of Technology, Leland Stanford University, the University of Michigan, and the University of Washington.

In addition, it has financed other educational work, including lectures on aeronautics and the publication of technical papers. And recently it organized a committee of eighty members, whose task is to solve the problem of aeronautical education in the primary and secondary schools throughout the country.

"That will give you some idea," he smiled, "of the extent to which we are interested in aviation as a career for young men." In fact this was the outstanding reason that prompted my father to endow the Fund.

"The future expansion of aviation will naturally depend largely on the character of its personnel. Young (Continued on page 166)

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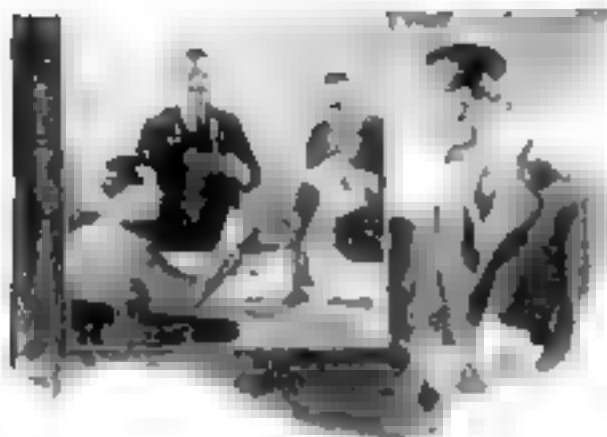
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If You Had Millions to Spend—

(Continued from page 166)

men who have had their imaginations kindled by the astonishing achievements in aviation in the past two years have been eager to take advantage of the opportunity which its rapid commercial development offers.

"We, too, receive numerous requests from young men for information concerning the training and the demand for mechanics and pilots. In order to answer these questions intelligently, the Fund not long ago addressed a questionnaire to operators of air transport companies, executives of aerial service companies, and aircraft manufacturers to ascertain to what extent a trained personnel is needed and to discover the best methods of supplying it.

"And this is what we found: The air transport companies that answered our questionnaire stated that most of their pilots were high school and college graduates with aeronautical training. When these pilots were employed, they already had an average of more than 1,000 hours of flying each to their credit. Five hundred hours of flying is the minimum required of new pilots by the air transport companies.

"Most pilots, they wrote, received their training in the regular Army or Navy or in the Reserve Corps. A few gained their experience in the commercial field. But the most desirable experience for their pilots, as the companies see it, is a combination of Army and commercial training.

"It developed that practically all aircraft manufacturers employ graduate engineers in their engineering departments. But while a technical education is deemed essential, only a small percentage of the graduate engineers employed had pursued specialized courses leading to a degree in aeronautical engineering.

"Yet, the demand for young men with highly specialized training is apparent, for the answers showed that, in employing additional personnel, the preference is given to graduates in aeronautics.

"The replies revealed that aeronautical graduates are especially needed in engineering departments where a knowledge of draftsmanship and structure is desired. For positions such as shop foremen, previous aircraft manufacturing experience is the most important requirement. On the other hand, for the higher positions a specialized education is a necessary qualification.

Here Are Correct Answers to Questions on Page 56

1. Aside from the stars and planets we can see, space is strewn with countless smaller bodies varying in size from that of an apple to the mass of a mountain. When these bodies, traveling at enormous velocity, strike the earth's atmosphere, the friction immediately causes their temperature to incandescence and we see them as shooting stars.

2. The sun, an incandescent body radiates light of all colors, which together make white light. But each of the gases around it absorbs one or more of the colors, so that there are hundreds of dark bands in the spectrum. By comparing the location of these bands in the spectra of the sun and other stars with the bands produced by known substances found on earth it has been assumed that the stars are made up of about the same materials as our own earth.

3. The distance to the nearest celestial body, the moon, is measured by simultaneously observing the angle in a given point on the moon from two widely separated points on the earth's surface and then solving the triangle thus formed by the aid of (Continued on page 167)

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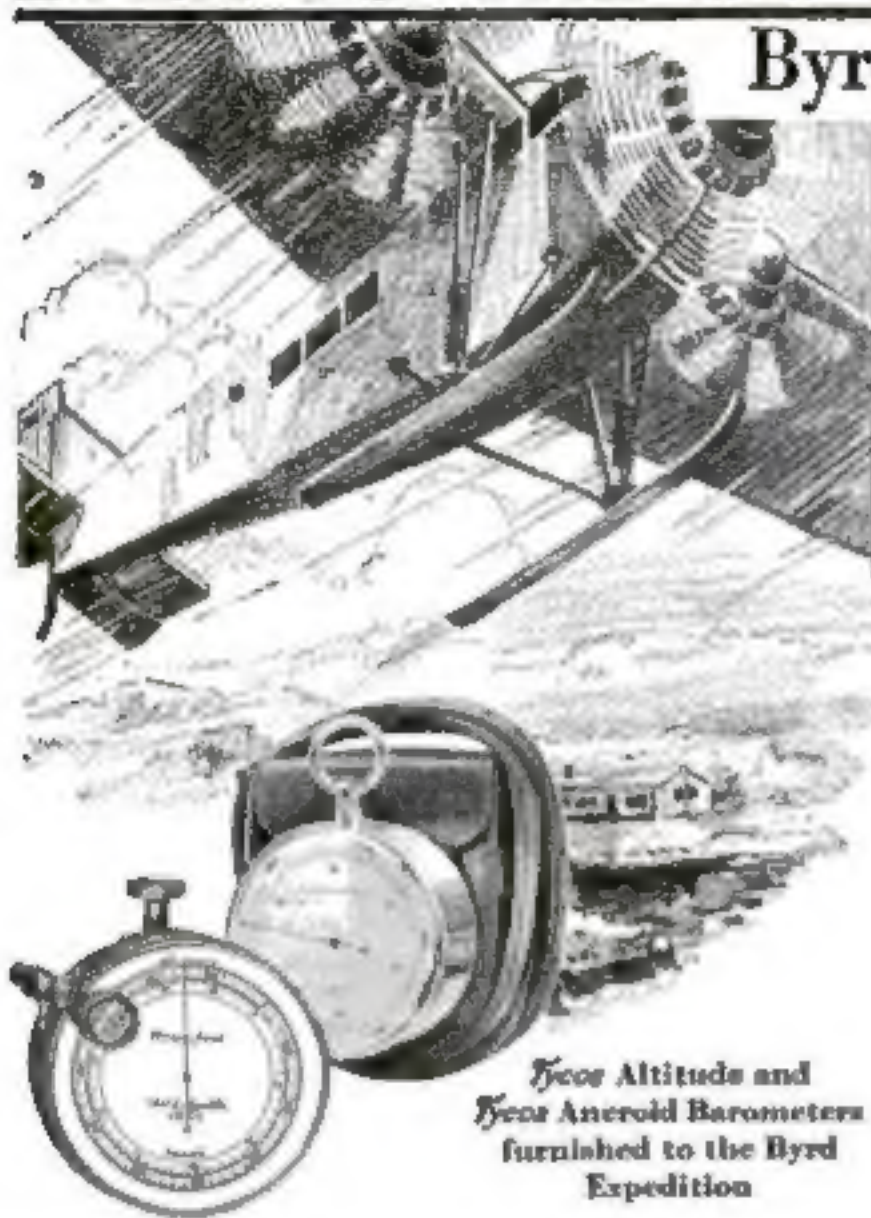
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"Three years ago I purchased a **KRISS-KROSS** stripper and have been using it ever since. It is without question one of the best and biggest money-saving investments of today."

J. E. WOLF, Wisconsin.

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